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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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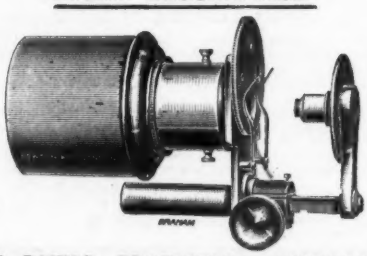

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A Course of Eight Advanced Lectures on "THE BIOCHEMISTRY OF THE STEROLS," by J. A. GARDNER, M.A. (Reader in Physiological Chemistry in the University), in the Physiological Laboratory of the University, South Kensington, S.W., at 5 p.m., on Tuesdays, May 18, 25, June 1, 8, 15, 22, and 29, and July 6. Syllabus obtainable on application.

A Course of Three Advanced Lectures in French on "LA TENSION PSYCHOLOGIQUE, SES DEGRÉS ET SES OSCILLATIONS," by Monsieur PIERRE JANET (Membre de l'Institut, Professeur de Psychologie au Collège de France, Paris), at the Royal Society of Medicine, 1 Wimpole Street, W., at 5 p.m., on Tuesday, Wednesday, and Thursday, May 11, 12, and 13. This Course will deal in part with the medical aspect of the question. Syllabus obtainable on application.

Provisional Notice.—A Course of Four Advanced Lectures on "HIGH-FREQUENCY ALTERNATORS FOR RADIO-TELEGRAPHY," by Monsieur MARIUS LATOUR, of Paris, has been arranged provisionally to take place at the Institution of Civil Engineers, Great George Street, S.W. 1, on May 26, 27, 28, and 31, at 5.30 p.m. A further announcement will be made.

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HERBERT REED,
Chief Education Officer.

Education Department,
15 John Street,
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E. SALTER DAVIES,
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May 1, 1920.

THURSDAY, MAY 6, 1920.

The Cost of Scientific Publications.

WE have had before us recently the annual reports of the councils of a number of scientific societies, and it is evident from all of them that the burden of the cost of publications of these societies has become so heavy that it cannot be borne any longer without additional support. The great increase in printers' charges, and the high cost of paper, make the expenses of publication so considerable that the slender funds at the disposal of most scientific societies, particularly those devoted to subjects having no direct association with profitable industry, will often not permit the substantial expenditure now required for the printing and distribution of papers presented at meetings. Few scientific societies have any other source of income than that provided by the subscriptions of their members or fellows, and science workers in general are already sufficiently harassed by the problem of their private budgets, with salaries little above the pre-war level, and relatively far below it on account of the rise in prices, that increased subscriptions cannot be contemplated without serious misgiving.

It has always seemed to us that in the pursuit of their researches and the publication of the results science workers follow principles on a far higher ethical level than that occupied by members of any other profession. The first object of their work is to increase the store of human knowledge, and the value of any communication to a scientific society is measured by what the explorer has brought back from a known region, or how far he has lifted the veil with which Nature jealously guards her secrets. Nothing must be kept back from the narrative of the discoverer, and the fruits secured must be displayed so that all who wish may enjoy them and be able to go out into the same fields to secure like riches for themselves.

In presenting the results of his labour to the human race without receiving any personal payment for it, the science worker occupies a unique position. Genius in art, or literature, or music may sometimes be neglected, but usually it secures generous reward, and its products have always a marketable value—high or low—whereas scientific discovery rarely brings direct gain to the genius who makes it. Plutocrats will pay high prices for the pictures they want, and popular authors and musical composers may amass riches from royalties on their works; but the science worker is deprived of any such rewards for his discoveries, though all the world may benefit by them. Not only does he bring his rich argosies into port, but he also describes his cargoes fully, and himself pays for the publication of the catalogue of gifts which he is prepared to bestow freely upon all who care to receive them. Such pure altruism is almost inconceivable to the ordinary business mind, yet it represents the common standard of scientific endeavour and achievement. Altered circumstances, however, make it necessary to reconsider this position, and we urge that it is time the community, through its rich citizens or the Government, provided reasonable contributions towards the expenses of publications which bring honour to them as well as add to the sum of human knowledge.

There is, indeed, no more difficult problem before our learned societies at the present time than that of the maintenance of their scientific publications. With a limited circulation which cannot be increased by the ordinary methods of enterprising journalism, the additional cost of production can be met only by a higher subscription. The societies which provide a library of their special subject already find most of their normal income absorbed by the increased establishment charges. As we have said, a very large proportion of the members of these societies are professional men whose incomes have not risen in proportion to the prices of the ordinary commodities of life. Any additional subscription to provide for an adequate record of the societies' activities under present conditions thus proves to be a hardship, sometimes an impossibility.

It may perhaps be admitted that, in the past, scientific publications have sometimes been produced in a rather extravagant style. Some societies have never completely emancipated themselves from this idea, and although a large format may sometimes be needed both for drawings of natural history and engineering, and for extensive mathematical formulæ, there has been less strict regard to such necessities than should have been exercised. Moreover, during the years before the war, with cheap printing, there was an increasing tendency in some departments of science to pour forth the undigested contents of notebooks rather than carefully considered results.

After all reasonable reform and economy, however, it still remains impossible to continue the serial publications of science with the means that

have hitherto been at its disposal. The question arises, therefore, whether help from some public source may not reasonably be expected. There is doubtless a very general popular feeling that ordinary scientific research is as much a recreative amusement to its devotees as are games and sport to the majority, and that those who indulge their whims should bear the additional cost like any other section of the community. But it must not be forgotten that there are various degrees of games and sports suited to the several means of those who pursue them, whereas ability and inclination to make and record scientific discoveries are in no way proportional to the resources of those who possess them. It must also be emphatically maintained that there is no basis for such a comparison. Science is undoubtedly an absorbing source of gratification to those who study its problems; but even the most abstract research, however far removed from the affairs of everyday life, is an asset of which no man can estimate the value.

In some directions the public has already become accustomed to the scientific spirit. It has begun, for example, to understand the value of preventive medicine. It no longer reserves its gratitude for those who discover remedies for disease; it realises the still greater importance of the work of those who try to learn the origin of disease and the influence of the environment upon the exciting cause. It should now be led to understand its debt to those who make advances in this and other branches of purely scientific work. The germs of all material progress and comfort are contained in our scientific serials and the publications of our scientific societies, and to allow a limitation of their scope is a hindrance to the public welfare.

The Government has already aided a few of the older and more important societies with a partial or complete grant of premises, and it entrusts an annual sum of money, given in the Estimates of 1920–21 as 11,000*l.*, to the Royal Society, to be distributed for scientific investigations by a committee appointed for that purpose, as well as 1000*l.* annually towards the cost of scientific publications. It has also established the important Department of Scientific and Industrial Research. We would now urge that a further step should be taken, and some direct endowment provided for those purely scientific publications which have for so many years been maintained by voluntary effort, both to the honour of the country and to the welfare of mankind.

Useful Physiology.

Physiology and National Needs. Edited by Prof. W. D. Halliburton. Pp. vii + 162. (London: Constable and Co., Ltd., 1919.) Price 8*s.* 6*d.* net.

PROF. HALLIBURTON and his fellow-lecturers have made out a good case for physiology having done its bit in the great war. The editor leads off with an account of the activities of the Royal Society and other committees in food control in general, and gives more particular details of the inquiries made in his own laboratory on the value of margarines and fatty acids. Vitamines occupy the whole of Prof. Hopkins's discourse, and Prof. Harden returns to them again with a summary of the work done on scurvy at the Lister Institute. But Prof. Harden is surely in error in saying that Lind held that scurvy was caused by abstinence from fresh vegetable food. That astute observer knew 150 years ago that scurvy could be cured by fresh vegetables, but he thought it was caused by living in confined, damp quarters, arguing that no one would say that ague was caused by abstinence from bark because it could be cured by giving bark.

Prof. Paton's essay on physiology in the study of disease is much less satisfactory. He is under a complete misapprehension of the aim and objects of medicine—a mistake shared in part by Prof. Halliburton—and medical men who read his solemn castigation of their empirical methods may not unreasonably retort that his discovery that tetany is due to the liberation of guanidin, controlled "somehow" by the parathyroids, has left medicine just about where it was. Prof. Paton seems to think that the object and business of medicine is to study disease. The object of medicine in reality is to prevent people feeling ill, and to make those who do feel ill feel better, and its success is to be measured by the product of the degree of betterment and its duration. "What the physician has to find out in every case," he says, "is simply what has gone wrong, and why it has gone wrong, before he attempts to put it right." So that if I have a headache and send for my physician, he is to engage with the hitherto insoluble problem of the nature and cause of the common megrinous headache (which is one of the great causes of human inefficiency, and no trivial matter) and solve it before he cures me by exhibiting 10 grains of aspirin: it might be good physiology, but it would be thoroughly bad medicine. The "practical man" is of course very wicked from our point of view, but he has been belaboured pretty freely these last few years; and, after all, he does a lot of practical good in

his blundering way. *Gerris*, as Mr. Belloc says, would sink if he stopped to meditate about the surface film, and he might get no nearer the truth than Prof. Paton does when he affirms that phosgene yields chlorine in the lungs. Knowledge helps practice truly enough, but to ask that practice shall stand still while a particular sort of intolerant knowledge gropes to a rationale will meet no national need whatever.

Prof. Dendy's interesting account of the ravages of weevils in stored grain and the means of preventing them tells, on the other hand, an excellent tale of practical empiricism. Prof. Dendy found, as on general grounds he expected to find, that the weevils soon perished if infested grain was shut up in air-tight receptacles in which the metabolism of the seeds soon replaced most of the oxygen by carbon dioxide, and he shows with a variety of experiments that air-tight storage is the practical method which is wanted: which appears to have been known from time immemorial and is expressed in the habit of Indians, Maltese, and others in storing their harvested grain closely in covered underground pits in face of the opinion that it was "absurd to hold that weevils require a free play of air or that free access of air is favourable to their existence," given by the entomological expert—doubtless a mere morphologist.

Natural man, indeed, as Dr. Pembrey argues in his breezy plea for the wild life, is apt to go right: "A sturdy growth of children is not to be obtained by the intelligent selection of the quality or quantity of their diet, but by the natural process of muscular activity in the open air, the appetite with its likes and dislikes acting as the guide in questions of food" (p. 158), which is not quite what the editor seems to say (p. 23). But the discrepancy is only on the surface: Sussex is not the Marylebone Road, and it is when civilisation interferes that trouble comes. Western refinements in rice polishing gave the East beriberi; a world trade in wheat gave the weevils their chance; mean and restricted lives brought in physical exercises instead of games. The truly physiological procedure, says Dr. Pembrey, is to put people where they can live a natural life by accumulated experience and to let them live it. "Bread and cheese" off the hedges is an older remedy than orange juice, and even scientific opinion has been taught by Prof. Leonard Hill that there is something to be said for our primitive open fires.

The book as a whole is extraordinarily interesting from many different aspects, as much perhaps for the questions it asks as for those it answers. "Physiology" is conceived in no narrow spirit; it is hygiene, pathology, bacteriology, and pharmacology, as well as itself. And in this generous field everyone will find a good many things worth thinking about. A. E. B.

Service Chemistry.

Service Chemistry: Being a Short Manual of Chemistry and Metallurgy and their Application in the Naval and Military Services. By the late Prof. Vivian B. Lewes and Prof. J. S. S. Brame. Fifth edition. Pp. xvi+576+vii plates. (London: Edward Arnold, 1920.) Price 21*s.* net.

THE late Prof. Vivian Lewes, of the Royal Naval College, Greenwich, an excellent teacher and an admirable lecturer, conferred a great benefit on the Service of which he was a member by the compilation of this manual. In the early days of the history of the college, the relation and importance of physical science to the business of the naval officer were but dimly appreciated by the authorities at Whitehall, and the scheme of instruction at Greenwich went but little beyond the standard of a public school which sought to develop its modern side. Prof. Debus, the first professor of chemistry, although a sound and remarkably well-informed chemist, carried with him to the college merely the traditions and methods of Clifton. The scope of his instruction of the naval lieutenant was practically that which had served him for years past in the several public schools to which he had been attached. He continued to teach chemistry simply as a branch of a liberal education, with no very direct reference to the life-work of those whom he addressed. It may be that at the outset of the career of the college no other course was open to him. The preliminary education of a naval officer at that period afforded no opportunity for him to acquire even the most elementary knowledge of science, and hence his teacher had of necessity to restrict himself to the kind of instruction which a well-ordered school system ought to have supplied.

Prof. Debus exercised a very salutary influence at the Royal Naval College. He was personally popular, and, in spite of certain little mannerisms, his quiet dignity and personal bearing enabled him to keep an effective control over a class of young men whose sense of humour is proverbially always acute and occasionally irrepressible. But to the budding Nelson, keen on his job, there must have been much in the professor's teaching that made no appeal. It probably seemed to him to have no possible relevance to the work of his pro-

fession. Prof. Lewes, who acted as chief assistant to Prof. Debus for some years and eventually succeeded to his chair, was no doubt fully conscious of this fact. At all events, his intimate association with the young officers in the laboratory must have afforded him abundant opportunities of learning it. When his turn came he entirely remodelled the course of chemical teaching. During the years of his assistantship he had been brought into frequent contact with Service and dockyard problems, in which his chemical knowledge and practical aptitudes could be turned to account. Prof. Debus was essentially the philosophic student; Prof. Lewes, with no pretensions to the academic attainments of his predecessor, was more a man of affairs, with a keen appreciation of the value of science to practice, and he could bring his experience to bear upon the character and style of his teaching.

The book before us was written to aid and supplement Prof. Lewes's instruction. It was unique of its kind. It bore directly upon what he conceived to be the true function of his chair. In one sense it is more restricted in scope than the ordinary text-book of pure chemistry, which seeks to cover more or less fully every department of the science, with no special reference to its practical application; in another sense it is wider, inasmuch as its subject-matter is intended to lead up to the far-reaching problems with which modern Service conditions deal.

A book based upon such principles can continue to be of value only so long as it has regard to the constant changes and increasing complexity of these conditions. Each successive edition bears witness that such regard has been held. The four previous editions of the work were issued under the direction of the original author, the fourth having appeared in the year before the outbreak of the war.

The present edition—the fifth—is due to Prof. Brame, Prof. Lewes's successor at the Royal Naval College. The plan of the work has not been altered in any essential particular. But the text has been carefully revised, and certain new features have been introduced. Greater attention has been paid to the applications of organic chemistry, especially in relation to fuels, explosives, and oils, mineral and vegetable. Also, the sections on boiler waters, corrosion, pigments, etc., have undergone considerable alteration.

It has become a truism to say that the great war through which Europe has recently passed was a chemist's war. Whether that is wholly true is a matter of opinion. But it is at least universally acknowledged that chemistry entered more largely into it than into any previous war. That fact alone adds interest and value to a book of this kind. Both arms of the Service now recognise that the operations of modern warfare are largely dependent upon chemical principles. That dependence is bound to increase in the future, and should therefore lead to a wider recognition of the importance of chemical instruction to all who may be concerned in the conduct of war, whether afloat or ashore. The book before us makes mention of many chemical applications and adaptations which the war originated; but the complete story has yet to be told, and in the present unsettled state of the world some time must elapse before it can be published. When, however, it is made generally known, it will constitute a triumph for the knowledge, skill, and resourcefulness of British chemists. That fact is already appreciated in the Naval Service, and by no section more warmly than by those who owe their chemical knowledge to the instruction they have received at the Royal Naval College.

T. E. THORPE.

Euclid's Elements.

Euclid in Greek. Book I. With Introduction and Notes. By Sir Thomas L. Heath. Pp. ix + 239. (Cambridge: At the University Press, 1920.) Price 10*s*. net.

THE editor of this text expresses the hope that it may be read by boys in the higher forms of schools. We hope so too, although the price of the book is rather prohibitive. At any rate, a copy should be obtained for the school library.

The text is accompanied by an introduction and a set of explanatory and critical notes; each of these is a model of its kind. In the introduction we have a summary of the contents of the elements, all the facts known about Euclid's life and works, and a full account of the principal translations and editions of the elements. The notes are extremely valuable in various ways. In the first place, the author is both a competent Greek scholar, and also a student imbued with the unadulterated spirit of Greek geometry. This makes his translations of technical terms eminently apt and trustworthy. As an example of his critical ability, we may take his discussion of the very difficult phrase ἐξ ἴσου in Euclid's definition of a straight line. He shows, we think conclusively, that the intention of the definition is to express that if any point on the (indefinite) line be taken, what we may call the aspect of the line therefrom is an "indifferent" one, with no bending one way or the other; in fact, we have an attempt at expressing in abstract terms the Platonic test—that a straight viewed "end

on" is a point. The editor keeps the time-honoured rendering "evenly"—we should prefer "equably" or "indifferently"; but this is of little importance, because, whatever term is used, it will have to be carefully explained. In any case, Simson's definition is a gross misrepresentation of Euclid, who evidently, however obscurely, states a property of a straight line in relation to all the points upon it.

Owing to the great popularity of the Elements, it is unlikely that we shall ever find out exactly the contributions made to geometry by Euclid's predecessors. Naturally, we should like to know what were the attainments of the Pythagorean school, and how far they were arithmetical or geometrical respectively. A still greater satisfaction would be to know how far the Greek theory of proportion was developed by Eudoxus. As presented in the Elements, it may fairly be called the crowning triumph of Greek mathematics; it is so near absolute perfection that no recent analysis can amend it, except perhaps by explicitly introducing what is known as the axiom of Archimedes. The question is, How far, if in any way, did Euclid improve upon Eudoxus's exposition?

We do not know whether Sir T. Heath intends to publish all the other books of the Elements. Those who are interested in Greek mathematical thought would be grateful for a similar edition of Euclid's arithmetical books, especially the tenth, which, as De Morgan pointed out long ago (in Smith's Dictionary of Classical Biography), contains an exhaustive discussion of a particular family of irrationals. Another boon would be an edition like this of some of the books of Apollonius's "Conics," especially those which virtually give the equations of conics referred to a principal diameter and the tangent at a vertex.

There is one point on which we venture, with all deference, to disagree with the editor. On p. 175 and elsewhere he translates πολλῷ μείζων by "much greater." The Greek idiom is peculiar, but unless we are to make it absurd we must render πολλῷ by "all the more," or some such phrase.

One remark in conclusion. Forty or fifty years ago, when a blind idolatry of Simson's "Euclid" was still the vogue, Euclid's fifth book was never read, and its theorems were assumed on the basis of Todhunter's "Algebra." In other words, the greatest achievement of Greek mathematics was absolutely ignored. It is a great mistake to assume that all who are in favour of modern methods of teaching are wholly out of sympathy with the classic exponents of their subject. On the contrary, those of them who are sane psychologists will always bear in mind that the progress of the individual is, in a way, a condensed image of the progress of the race, and they will be the last to ignore the historical development of their subject, whether it be mathematics, or philosophy, or chemistry, or anything else. G. B. M.

The Earliest Flint Implements.

Pre-Palaeolithic Man. By J. Reid Moir. Pp. 67+29 plates. (Ipswich: W. E. Harrison; London: Simpkin, Marshall, Hamilton, Kent, and Co., Ltd., n.d.) Price 7*s.* 6*d.*

IN this little volume Mr. Reid Moir treats of the various forms of flaked flints found in deposits older than those in which ordinary palæolithic implements occur. He also describes the experiments in flint-fracture which have convinced him that the specimens in question are examples of human workmanship. Most of the matter has already appeared in various papers by the author, and many of the illustrations are from these papers, but the whole is a useful summary which the general reader will be glad to have in so convenient a form.

Among flints like the so-called eoliths, which are very little shaped by chipping, it must naturally be difficult to decide which have been flaked by man for his own use, but Mr. Reid Moir considers that they can be distinguished by the shape and appearance of the flake-scars. According to his experiments, the scar left by fortuitous percussion is comparatively wide and truncated, and often marked by concentric lines, while that made by human flaking is longer than it is wide, tapering at the far end, and not marked by concentric lines. If this criterion be trustworthy, it is evident that man's earliest handiwork can be recognised, for when he first began to use stone he must have selected pieces which were already of the needed shape, and he merely trimmed certain edges for greater effectiveness.

Man's first efforts to shape a real implement are supposed to have resulted in the rostro-carinate type, and this by further chipping gradually passed into the familiar palæolith. Mr. Reid Moir describes the process of change, as further discussed in his memoir in the Philosophical Transactions which was noticed in NATURE for April 1, p. 146. He also, as in the memoir just mentioned, expresses the opinion that the Acheulean and the Mousterian forms of palæoliths have been derived from the rostro-carinates in somewhat different ways. The speculation is interest-

ing, and the argument is easily followed with the aid of the many accompanying illustrations.

Mr. Reid Moir's final chapter on "Pre-Palæolithic Man in England" is more discursive, and suggests that we should turn to England rather than to Asia for the earliest traces of man. The detritus-bed at the base of the Pliocene Red Crag near Ipswich is described as yielding rostro-carinate and other worked flints. The age of the Piltdown skull is also discussed, and it is regarded as Pliocene. The conclusion is that English "pre-palæolithic" deposits should be more carefully studied than they have been hitherto, and the little book before us cannot fail to stimulate such study.

The Heat Treatment of Cast Iron.

Malleable Cast Iron. By S. Jones Parsons. Second edition, revised. Pp. xi+175. (London: Constable and Co., Ltd., 1919.) Price 14*s.* net.

THE first edition of Mr. Parsons's book on malleable-iron founding was published in 1908. A second edition has now been issued. It differs principally from the first in that it contains two new chapters, one dealing with mixing by analysis, the other with the measurement of temperature. There is also a brief addendum on what is called "malleable cast steel."

The high percentage of "waster" castings formerly produced in malleable-iron foundries has undoubtedly been reduced in the interval which has elapsed between the appearance of the two editions by adopting a more scientific method of making up mixtures according to chemical standards; but this alone is not sufficient to ensure a continuous output of good malleable castings. There has always been an undue amount of wastage in the annealing process, chiefly owing to irregularities in the temperature of the ovens. This is inevitable when there is no means provided for measuring the temperature. In the best foundries the hopelessness of relying on the purely human element has long been recognised, and it has now been proved by the use of suitable pyrometers that a considerable saving in fuel may be effected and the percentage of waster castings due to imperfect annealing almost entirely eliminated. The chapter on temperature measurement gives a brief account of optical and thermo-couple pyrometers and the methods of using them in this industry.

It is somewhat surprising that in a book which is evidently designed to assist the malleable-iron industry to more scientific methods of production there is no mention of the light thrown by the microscope on the structural changes which occur in the malleablising process; nor is there any reference to the mechanical properties of the various types of iron produced. It is the microscope which has shown what the essential difference is between European malleable iron, which dates back to the time of Réaumur, and the modern "Black Heart" variety, which is an American product. This instrument affords a valuable means of controlling the extent of the malleablising action of the annealing process.

A valuable account of these two aspects of the scientific control of malleable iron is to be found in Dr. Hatfield's book "Cast Iron in the Light of Recent Research." If a third edition of Mr. Parsons's book is called for he would be well advised to include a reference to these additional methods of control.

Our Bookshelf.

The Running and Maintenance of the Marine Diesel Engine. By John Lamb. Pp. xii+231+4 plates. (London: Charles Griffin and Co., Ltd., 1920.) Price 8*s.* 6*d.*

THIS book opens with brief descriptions of the properties of oil fuels, combustion, the modes of working of four-cycle and two-cycle engines, and the general arrangement of the marine Diesel engine on board ship. The remainder of the book is taken up with descriptions of details and the manner in which these operate; sections are included dealing with high-speed Diesel engines for driving dynamos and fans, steering-gears, running troubles, and lists of stores which should be carried. The book is profusely illustrated with diagrams showing the construction of details; as the author's object has been merely to explain the mode of working, many of these diagrams have not been drawn to scale; detailed descriptions of parts which are common to all classes of engines, *e.g.* connecting-rods and crank-shafts, are not included.

The book will appeal to and be found useful by a large class of engineers whose experience has been confined to the steam engine, both by reason of the clearness of the matter included and by the many useful hints which the author's four years' sea-going experience in motor ships has enabled him to give. For example: "In the same vessel the scavenging valves would intermittently fail to close, frequently to such an extent that the escape valves on the scavenging air pipe would lift. The scavenging pumps drew the air through a ventilator passing up through the deck. It was afterwards found that scale from the inside of the ventilator was the cause of the valves failing to close. The air was then taken from the engine-room, when no further trouble was experienced." Obviously hints of this kind are of service not only to the engineer on board ship, but also to the

designer. We can recommend the book to all engineers desirous of obtaining information on the running of Diesel engines.

A Course of Practical Chemistry for Agricultural Students. Vol. i. By L. F. Newman and Prof. H. A. D. Neville. Pp. 235. (Cambridge: At the University Press, 1920.) Price 10*s.* 6*d.* net.

MR. NEWMAN AND PROF. NEVILLE have brought into three volumes details of a practical course of agricultural chemistry designed for students taking degrees in agricultural science; the present volume deals with the chemistry and physics of the soil. Much of the book is concerned with pure chemistry and pure physics (physical properties of gases, density, specific heat, etc.), and has no special connection with agriculture as distinct from any other branch of science; only about one-third is devoted to soils and manures.

The exercises appear to be well chosen, but one cannot help wishing that the authors had used one of the many books already published on pure chemistry, and given more space to agricultural problems.

The exercises on soils and manures are mainly analytical; they are on the usual lines, and intended obviously for elementary students, for whom the instructions should be found sufficient. Had there been more space available, some more inspiring exercises might well have been given, especially in the direction of pot and plot experiments. Many of the properties of soil are more easily demonstrated out of doors than indoors, and in any case the principles of soil fertility cannot be elucidated entirely by purely laboratory work. Numerous experiments have been devised, but they are scattered about over a number of text-books and have never been collected.

Within the limits they have set themselves, the authors have produced a useful book which will be helpful to teachers, especially in these busy times, when classes are large and demonstrators very hard-worked.

The Mason-Wasps. By J. Henri Fabre. Translated by Alexander Teixeira de Mattos. Pp. vi+318. (London: Hodder and Stoughton, n.d.) Price 7*s.* 6*d.* net.

THE writings of few open-air naturalists have equalled, or even approached, in ease and attractiveness of style the "Souvenirs entomologiques" of J. H. Fabre, the veteran observer of Sérignan. Much of the charm of these essays has been preserved in the skilful translations by A. T. de Mattos, of which the present work is an example in no way inferior, either in interest or in wealth of accurate observation, to the other volumes of the series. In it are recorded the results of a minute and careful study of the life-history of wasps belonging to the genera Eumenes, Odynerus, Pelopœus, Agenia, and Vespa, related with the utmost simplicity and vividness, and illuminated by the lively and charming personality of the author.

Leaving the domain of pure observation and experiment, and entering on that of bionomic speculation, we find Fabre a less satisfactory guide. It is well known that no theories of evolution appealed to him in the least degree, and the *naïveté* with which he touches and dismisses the problems of mimicry and protective resemblance in the volume before us gives a key to the reasons of his failure to appreciate the greatest advances in biological science of his time. On the other hand, his views on the subject of instinct, fortified by ingenious experiments on the mud-building and spider-storing habit of Pelopœus and on the cocoon-weaving procedure of Saturnia, are sound enough. But it is difficult to follow him in the distinction that he draws between "instinct" and "discernment"; nor can one take seriously his playful remarks on the mental processes involved in insect activities. F. A. D.

The Handbook of Cyprus. Eighth issue. Edited by Harry Charles Luke and Douglas James Jardine. Pp. xii+300. (London: Macmillan and Co., Ltd., 1920.) Price 12*s.* net.

TO every Englishman—and by that we mean every English-speaking citizen of our Commonwealth—Cyprus suggests, not the succession of love-cults, but that one great lovers' meeting when Othello came to land. "Once more well met in Cyprus." This new issue of the official handbook assures us that the island is now a Crown colony of Britain. Let us trust that its authors, who are both administrators of empire, in reviewing their work among its mixed inhabitants, may record that they "have found great love amongst them."

It is rare to find a publication that in its essence is economic and statistical allowing also for the taste of visitors in archæology and natural history. Enough is here given in a small compass to lead the reader on to the works enumerated on pp. 93–95 and in the sections on geology and zoology. It would have been well if the treatment of the geology had been connected with the brief geographical section which occurs some two hundred pages earlier. The comparatively recent origin of the islands of the Levant, consequent on the breaking up of the Ægean land, is the real basis for the history of merchant fleets. The dwarf elephant and hippopotamus, so well included under Natural History on p. 246, are effective links in the romance. We find so much in this invitation to the isle that we should like to arrange it more in sequence, so as to produce the true geographical effect. Perhaps each reader will do this for himself as he journeys eastward, sure of welcome. G. A. J. C.

An Introduction to Social Psychology. By Dr. W. McDougall. Fourteenth edition. Pp. xxiv+459. (London: Methuen and Co., Ltd., 1919.) Price 7*s.* 6*d.* net.

IN this edition, among other changes, the principle is elaborated that all emotion is the affective aspect of instinctive process.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Organisation of Scientific Work.

I HAVE only recently seen the article in NATURE of February 19 and the correspondence so unanimously supporting the view that the present decentralised system of team work by experts in different branches of science in agricultural, forestry, and medical research institutes is greatly superior to the proposed centralisation in distant Simla of each separate science —chemistry, botany, etc.—under directors of research with autocratic powers to decide what each original worker in his branch throughout India shall investigate and publish; for it is clearly impossible in these days for one man to be sufficiently conversant with each special division of his science adequately to fulfil such a stupendous task. I desire to associate myself with that view, which may be illustrated by my experience in organising the Calcutta School of Tropical Medicine, shortly to be opened, for which I have just obtained endowments from two successful European and Parsi business men for a whole-time biochemist, in addition to two other chemists for the analysis of indigenous drugs and of food and water respectively, all three of whom will aid nine medical research investigators in team work at important medical problems under a medical director. Could anyone contend that these very specialised chemists would be better controlled by a purely chemical director a thousand miles away in Simla, who could know nothing of the medical problems they will investigate?

On the other hand, if the Government of India is to provide the large sums urgently required for the further development of scientific research in India, it will require some organisation to co-ordinate and report on the work it will be financing. May it not learn a lesson from the Medical Research Committee of eminent medical men of science, which is wisely utilising the large sums supplied by the British Government in assisting the investigations of university and medical-school workers with established reputations and with a minimum amount of interference? A very similar and successful organisation was set up in India when the late Sir Pardey Lukis persuaded the Government of India to hand over five lakhs (some 50,000*l.*) a year to the Indian Research Association, administered by a governing body on which the medical members, through their special knowledge of the subject, exercise a preponderating influence; while I have recently obtained a purely medical governing body to administer the endowments of the Calcutta School of Tropical Medicine with an income of some 11,000*l.* a year, which I have been fortunate enough to raise to provide both men and apparatus without the long delays, usually of several years' duration, involved in obtaining the sanction of the Government of India and of the Secretary of State for new posts.

This plan has thus already proved its value and is capable of extension, while boards composed of a number of men of science of high standing will command much greater confidence than an autocratic director of research. The nucleus of such a body already exists in the Board of Scientific Control, which meets twice a year in Delhi and Simla, and might with greater advantage hold its principal meeting coincidently with the Indian Science Congress in one of the large centres of research. At a meeting in Delhi in December, 1918, I advocated, in place of an autocratic director of medical research, that an inspector of research might be appointed, who would not attempt the invidious task of laying down what each research worker should investigate and publish, but would visit different research laboratories and consult with their respective directors or councils regarding the financial and other needs of the institutes, and help to co-ordinate the work in different parts of India to prevent waste through overlapping. The recent correspondence in NATURE confirms me in that solution of the difficulty, and I venture to think that in some such ways as I have suggested the established advantages of the present decentralised system may be retained and strengthened by greater and more elastic financial aid, and be better co-ordinated, without introducing the highly objectionable autocratic and distant centralised control of the proposals now before the Indian Government to which you have directed such timely attention.

LEONARD ROGERS.

South Devon, April 29.

The Small Islands of Almost-Atolls.

THE familiar inductive series of fringing reefs, barrier reefs, and atolls may be further subdivided so as to contain six members: Normal fringing reefs, offshore fringing reefs, narrow-lagoon barrier reefs, broad-lagoon barrier reefs, almost-atolls, and atolls. Almost-atolls, or atoll-like reefs encircling lagoons in which one or several small islands rise, are of interest as affording a critical test of certain competing coral-reef theories, as follows: Murray's theory of outgrowing reefs around still standing islands explains a completed atoll by supposing that the original volcanic island is slowly worn down as the encircling reef grows outward and the lagoon is excavated behind the growing reef by solution, the degraded central island eventually disappearing in a way not clearly explained, perhaps by outwash of its detritus from the lagoon by currents which are fed by the influx of surf over the windward reef and discharged by outflow through passes in the leeward reef. Under this theory the small island of an almost-atoll would be a nearly worn-down central island, which would exhibit rolling hills of low relief surrounded by delta flats; or in a later stage, after the delta deposits had been swept away, the low hills of the vanishing island would be encroached upon by the lagoon waves and cut back in low bluffs fronted by low-tide rock platforms that gradually deepen into the lagoon.

According to Daly's Glacial-control theory, atoll reefs are built up from the margin of platforms abraded by the waves of the lowered Glacial ocean across still standing islands that had been previously worn down to low relief by long-continued normal erosion, the reefs being built up as the ocean rises in post-Glacial time. Under this theory an almost destroyed central island would have a surface of rolling hills, cut back by cliffs which would now—except for fringing reefs that may border them—plunge into the lagoon waters to a depth of twenty or more fathoms. This inference is well supported by the occurrence of strongly clift islands surmounting submarine banks of moderate depth in the extra-tropical seas. According to Darwin's theory of up-growing reefs on intermittently subsiding foundations —submergence by subsidence being faster than erosional degradation—atolls are produced when the central island of an up-growing barrier reef has sunk out of sight. Under this theory the lagoon of an

almost-atoll would contain one or several nearly submerged islands of mountainous or mountain-top form.

The characteristics of the small islands of hypothetical almost-atolls, as thus deduced from several theories of coral reefs, may be confronted with the appropriate facts as represented in five actual almost-atolls: The Hermit Islands, in the Admiralty group north of New Guinea; Truk or Hogoleu, in the Caroline Islands; Budd Reef, in north-eastern Fiji; the Great Astrolabe Reef, in south-western Fiji; and Mangareva or the Gambier Islands, south of the Paumotus. The Hermit Islands are enclosed by a reef about 12 miles in diameter; the largest of the islands is 3 miles long and more than 3000 ft. in height. The encircling reef of Truk is about 30 miles in diameter, and encloses some twenty small islands; the largest measures 6 by 3 miles, and several of the larger ones are from 1000 ft. to 1300 ft. high; the smaller ones rise from 20 ft. to 300 ft. Budd Reef measures 12 miles in its longest diameter; three small islands, each less than a mile across, rise from 280 ft. to 480 ft. near the lagoon centre; a small horseshoe crater island, a mile in diameter and 590 ft. high, near the north-eastern angle of the enclosing reef, appears to be of much more recent origin than its neighbours, and does not bear on the problem here considered. The Great Astrolabe Reef makes an oval loop, 6 miles wide by 10 miles long, around a lagoon containing nine small islands; it is not properly an almost-atoll reef, for on the south it continues a long distance around the four-mile island of Ono and the thirty-mile island of Kandavu. However, the small islands that its northern loop surrounds are typical residuals; the largest is scarcely a mile in length, the highest rises 460 ft.; all are of rounded, mountain-top form, their small spurs being a little cut back by shore-line cliffs, which rise from low-tide rock platforms and do not plunge into deep water. Moreover, a triangular space defined by three of the islands, a mile and a half on its open sides, has the same depth of from 17 to 20 fathoms that prevails between the islands and the barrier reef; and this is beyond explanation by the Glacial-control theory. Gambier Reef is from 12 to 15 miles across; the enclosed islands are eight in number, and the largest of them measures 4 by 2 miles and has a height of 1300 ft. Dana wrote of the larger of these islands: "The very features of the coast—the deep indentations—are sufficient evidence of subsidence to one who has studied the character of the Pacific islands; for these indentations correspond to valleys or gorges formed by denudation during a long period while the island stood above the sea" ("On Coral Reefs and Islands," 1853, p. 95). Within the polygon defined by several of these islands two soundings give depths of 38 fathoms, while the lagoon outside the polygon has no depths so great.

All these almost-atoll islands are of mountainous or mountain-top form; they appear to be residuals of originally larger islands, much reduced by sub-aerial erosion and now isolated by submergence. The smaller ones are mere summits, too small to show embayed valleys; the larger ones have somewhat embayed shore-lines, which would, according to the best accounts that I can gather, be more strongly embayed if the deltas that now partly occupy the bays were removed. None of the islands are described as strongly cliff, like those of the extra-tropical seas, although some headlands are a little cut back in low bluffs fronted by low-tide rock platforms, evidently the work of the lagoon waves at present sea-level. It thus appears that the small islands of actual almost-atolls are excellent counterparts of the mountainous or mountain-top islands of hypothetical almost-atolls deduced as the necessary consequences of Darwin's theory, but such islands cannot be accounted for by either Murray's or Daly's theory.

The attention of European men of science has been so largely withdrawn from the study of coral reefs during the last thirty years that the coral-reef problem now has scarcely a hearing among them. It is to be hoped that, with the acquisition of the numerous islands and reefs of northern and eastern New Guinea with the neighbouring reef-encircled islands by Australia, the old problem may be taken up again by the explorers and investigators of that remarkable region. The Louisiade group in particular deserves attention. The present communication suggests some of the newer aspects of coral-reef study, which, along with the embayments of reef-encircled islands and the unconformable contacts of fringing and elevated reefs with their foundations (see "The Geological Aspects of the Coral-reef Problem," *Science Progress*, xiii., 1919, pp. 420–44), must be taken into account for the future. All considered together, these newer aspects go far towards restoring confidence in Darwin's theory, which between 1880 and 1910 was so unreasonably discarded by many writers. The theory needs subordinate modification by the addition of changes of ocean-level during the Glacial period, to which Daly has so justly directed attention; but those changes acting alone would, whenever they occurred, produce emergences or submergences everywhere alike in their moderate amount, their slow rate, and their Pleistocene date; while all the reef-encircled islands that have yet been studied—as, for example, in Foye's "Geological Observations in Fiji" (Proc. Amer. Acad. of Arts and Sci., liv., 1918, pp. 1–145)—testify to submergences and emergences at dates that are frequently unlike from place to place, and of amounts that are frequently much in excess of the most liberal estimates of Glacial changes in ocean-level. Such submergences and emergences are, therefore, to be explained by local movements of subsidence or upheaval in the islands concerned. As reef-growth has been associated chiefly with the various movements of subsidence, reinforced recently by rise of ocean-level, Darwin's theory subordinately modified is thereby supported.

W. M. DAVIS.
Harvard University, Cambridge, Mass.,
March.

Scientific Apparatus from Abroad.

THERE is one aspect of the proposed "anti-dumping" legislation to which I should like to direct attention.

While there is much scientific apparatus made in the British Isles of a quality at least as good as that imported, it is, unfortunately, very costly. But there are also many articles which our manufacturers have not yet learned to produce in anything like a satisfactory quality. The result of restricting the import of good articles by a heavy duty would be to compel scientific workers to use home-made goods. There would be no hardship if these goods were satisfactory. But such is by no means always the case, and we are then penalised by waste of time and frequent loss of experimental results. Moreover, if inferior goods obtain a sale by methods of this kind, no inducement is given to the makers to improve the quality.

I am aware that I may be called a doctrinaire Free Trader, but it seems to me to be a far more reasonable procedure to allow free import of such apparatus *until* equally good material is to be had cheaply at home. In the meantime, our manufacturers should,

if necessary, receive State aid to enable them to perfect their processes. When they can show that they have attained success, an import duty might be imposed temporarily on the foreign substitute to ensure the sale of the British article and to introduce it to the market. If the product is satisfactory, there would be no need to retain the duty for any great length of time.

Owing to the present poor rate of pay of free scientific workers, it is only just to give them generous grants if they are compelled to buy the costly home-made goods of the first category referred to above.

It will surely be admitted that the desirable state of affairs is that each country should produce what it is best fitted to do, and that there should be no necessity for protective duties. But if the League of Nations is believed to be ineffective, and if we must be prepared to be self-supporting in case of another great war, it behoves those who advocate measures to bring this about to see that the nation does not lose more than it is likely to gain.

I have confined my remarks to the case of scientific appliances, but similar considerations apply to many industrial processes. Inferior material and machinery would have to be put up with for the sake of supporting some other industry. If the foreign goods are superior they should be freely imported, and the British makers subventioned until they can produce equally good material, if it is thought essential that they should do so.

W. M. BAYLISS.

University College, London.

The Cost of Laboratory Fittings.

IN all directions we have at the present time evidence of a growing enthusiasm for education in the field of natural science. Students are being turned away from our schools and universities for lack of accommodation, and the new Education Act has given great encouragement to science teaching. Our war experiences seem to have aroused the nation to the necessity for vastly extending the facilities for these studies, and at the same time the need for financial economy is pressing in all directions.

The material requirements of science teaching are expensive, and, though heavy outlay is in the main inevitable, it seems probable that if costs cannot be reduced the very necessary expansion of science in our schools may in many cases have to be deferred or abandoned, and, possibly, curtailed in our higher institutions. The character of the fixed fittings in our laboratories has altered but little for many years, and it seems pertinent to inquire whether something could not be done by the use of alternative materials or by standardisation to reduce their cost.

I recently brought this matter to the notice of one of our learned societies, and received a very cordial reply from its council, which has referred the question to the Department of Scientific and Industrial Research; and I have reason to believe that this Department is proposing to take some action, in which event I have arranged that the Science Standing Committee of one of our Royal institutes shall be represented at any deliberations. Things, however, move slowly and time is passing, which must be my excuse for troubling you with this letter in the hope that the subject may raise some interest, and possibly lead to some constructive suggestions.

There are several obvious directions in which research on this subject, which should be neither particularly lengthy nor expensive, seem likely to be fruitful, but I must not encroach further by elaboration.

ALAN E. MUNBY.

9 Old Square, Lincoln's Inn, W.C.2.

The Standard of Atomic Weights.

IN reply to the letter of Prof. J. R. Partington appearing in NATURE of April 29, it has already been announced in your columns that Dr. Aston has shown neon and chlorine to be each mixtures of two isotopes with atomic weights which are whole numbers, and I have suggested that the atomic weights of all the elements with low atomic weights are very approximately of the form $2x+a$, where x is the atomic number and a a small integer, and there are indications tending to show that a is independent of the chemical properties of the element (see NATURE, February 26, p. 704). For the lower atomic weights the calculation is not greatly affected whether the atomic weight of hydrogen or of oxygen is taken as the standard. With the exception of hydrogen, no atomic weight is less than $2x$, if the atomic weight of oxygen is taken as the standard. There is, accordingly, some justification for treating the atomic weights of helium, boron, carbon, nitrogen, oxygen, and fluorine as normal and that of hydrogen as abnormal. If, as appears to be the case, the atomic weights are not only variable, *e.g.* lead, neon, etc., but also contain a quantity independent of the chemical properties of the element, the determination of the relative atomic weights of two elements to a high degree of accuracy will in many cases be impossible, and in some others futile.

In some respects it might be convenient to take helium as the standard for atomic weights, this element certainly assisting in a few instances to build up the atomic weight, and as helium can now be prepared in large quantity the accurate determination of its density will not be so difficult as heretofore.

STEPHEN MIALL.

28 Belsize Grove, N.W.3.

The Mole Cricket.

ONLY one British species of mole cricket is known, *Gryllotalpa vulgaris*. It is now becoming very rare in England. It is largely carnivorous, and by burrowing underground with its powerful fore-legs, which by a shear-like action cut through roots, it causes a certain amount of damage. It is by the peculiar

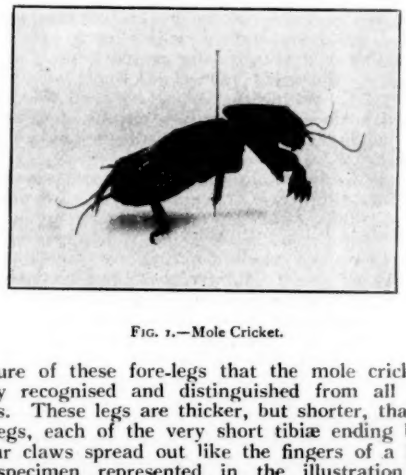

FIG. 1.—Mole Cricket.

structure of these fore-legs that the mole cricket is readily recognised and distinguished from all other insects. These legs are thicker, but shorter, than the hind-legs, each of the very short tibiæ ending below in four claws spread out like the fingers of a hand. The specimen represented in the illustration was caught at Send, near Woking, in Surrey, on March 15 last.

F. V. D.

The Optophone: An Instrument for Reading by Ear.

By DR. E. E. FOURNIER D'ALBE.

THE type-reading optophone, an instrument designed to enable blind people to read ordinary print, was described in NATURE in 1914 (vol. xciv., p. 4). At the British Scientific Products Exhibition of 1918 some public reading demonstrations were given with a somewhat improved apparatus exhibited by the writer and by Mr. W. Forster Brown (see NATURE, vol. cii., p. 10, September 5, 1918). These demonstrations sufficed to show that all the essential problems of type-reading had been solved, but the instrument then exhibited had certain defects which militated against its prolonged and convenient use by blind persons. Thus, the displacement along the line of type was effected by turning a handle, which no blind person would care to use by the hour. The construction of the apparatus generally was not sufficiently solid and substantial, in view of the fact that it had to be put into the hands of a necessarily somewhat clumsy operator.

After the close of the exhibition the construction of the instrument was undertaken by Messrs. Barr and Stroud, Ltd., of Glasgow, the well-known makers of range-finders and fire-control apparatus for the British and foreign navies. A great deal of thought and care has been bestowed upon the instrument by Dr. Archibald Barr, and the result has been a thoroughly sound, compact, and practical instrument, such as was shown by Dr. Barr in his lecture to the Royal Philosophical Society of Glasgow on March 24 last.

The general principle of the apparatus is shown by Fig. 1. A siren disc, D, is run at about 30 revolutions a second by means of the small magneto-electric motor shown. It contains five circles of square perforations, the innermost circle having twenty-four perforations, the outermost forty-two, the other circles being intermediate and corresponding to the relative frequencies of certain notes of the diatonic scale. A line of light in a radial direction is provided by the festoon lamp L, and the image of the filament of this lamp is thrown upon the print by a system of three lenses on the other side of the selenium tablet S. The axis of the concavo-convex lens C is slightly tilted out of the axis of the other lenses for a purpose which is specified below. The general result of the optical system is to give a line of luminous dots on the print, each dot having a different musical frequency. The light constituting these dots is diffusely reflected back on to the selenium, which is put in circuit with a battery and a high-resistance telephone receiver. Those dots which fall on white paper produce a note of their own musical frequency in the telephone, while those which fall on black are extinguished. We thus get what may be called a "white-sounding" optophone, in which the black letters are read by the notes omitted from the scale rather than by the notes which remain sounding. All the reading demonstrations hitherto undertaken have been given with a "white-sounding" optophone.

A modification of this principle, introduced by Messrs. Barr and Stroud in consultation with the writer, is the provision of a second selenium preparation in the form of a cylindrical rod, the top of which can be seen at B (Fig. 1). This rod receives the light reflected by the concave surface of the lens C, which produces a real image of the line of dots on a generator of the cylindrical rod, and by turning this rod about its axis the image can be made more or less effective as desired. By balancing the effect on B against the effect on S, when white paper alone is exposed, a silence can be produced in the telephone, and the effect of the passage of a black letter is to make a sound which varies in accordance with the formation of the letter. This is the principle of what may be called a "black-sounding" optophone, and

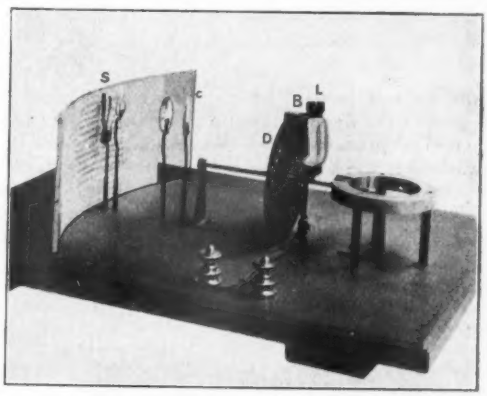

FIG. 1.—Skeleton apparatus showing the principle of the optophone.

although its advantage over the white-sounding type has yet to be proved, there is little doubt that the learning of the alphabet sounded on the new principle will be easier, though in the writer's opinion the ultimate speed acquired by either black-sounding or white-sounding will be approximately the same. It is interesting in this connection to note that Miss Mary Jameson, the blind girl who gave the demonstrations at the 1918 Exhibition, now reads habitually at a speed of about twenty-five words a minute with a "white-sounding" optophone made by Messrs. Barr and Stroud, and finds, indeed, that when the instrument is adjusted for a lesser speed reading becomes more difficult.

The present construction adopted by Messrs. Barr and Stroud is shown in Fig. 2. The disc, lamp, lenses, and selenium, as well as the motor, are all mounted in the swinging "tracer," which

can be brought over to the right by means of the reading-handle H. It then returns to the left with a slow, silent, and steady motion regulated by the worm gearing W, which drives a small paddle inserted in a viscous liquid. This paddle can be inserted more or less deeply into the liquid by the regulating nut R, and such is the range

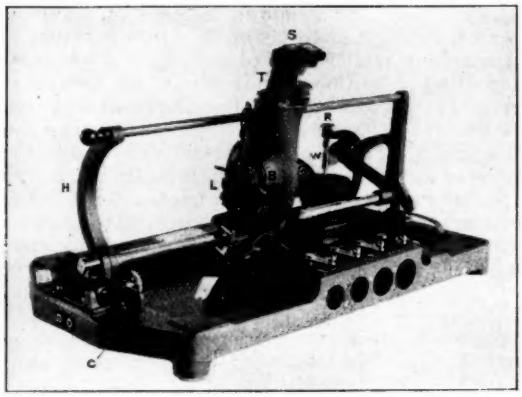

FIG. 2.—The optophone with book-rest removed.

of adjustment possible that a line can be read in anything from five seconds to five minutes, according to the proficiency of the reader. When the line is read, the next line is brought into focus by the change-bar C, which works a friction grip inside the bar on which the "tracer" is pivoted, and can be adjusted for any desired line space

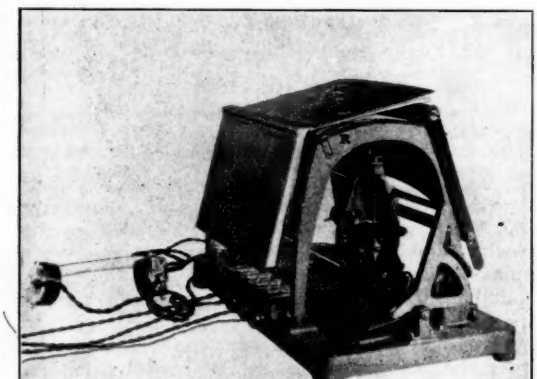

FIG. 3.—The optophone complete with book-rest.

by means of the screw attached to the change-bar. A lever attached to the "tracer" enables the operator to reverse this motion or to release the whole "tracer" from the friction gear, so that it may be quickly brought to the top of a page.

The festoon lamp is inserted at L, where it is held by a spring clip, and whence it can easily be removed for renewal even by a blind operator. The balancer is inserted at B, and can be adjusted for silence by means of the small handle shown.

Fig. 3 shows the apparatus from the top page end and with telephone and flex connections attached, as well as the book-rest R holding a book. The adapters of these flex connections are all of different sizes, and fit into different-sized holes in such a manner that they cannot be wrongly inserted—an important consideration with blind operators.

The various connections with their switches are for the motor, the lamp, and the two selenium circuits respectively. When the adapters are removed, a cover can be placed over the whole instrument, which clips on to the aluminium base, and the optophone can thereupon be carried about like a typewriter.

Fig. 4 shows the manner in which the instrument is manipulated by a blind person.

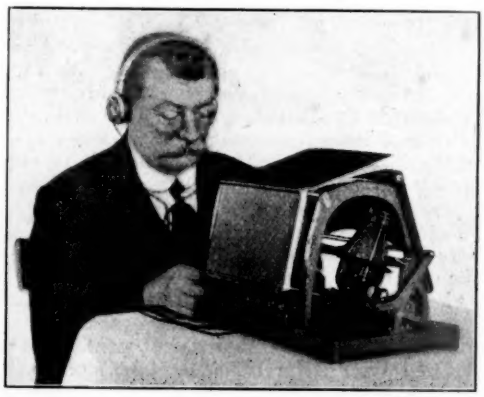

FIG. 4.—Line-changing with the optophone.

Special mention ought to be made of a contrivance for adjusting for various sizes of type. The middle lens of the three shown in Fig. 1 is mounted in a nut which can be screwed up and down within the "tracer" by means of two gaps cut in the upper cylindrical portion at T (Fig. 2). The nut is provided with six nicks across the rim, which enable a blind operator to count the number of turns of the nut, and thus to adjust for any definite size of type. This ingenious contrivance is, I believe, due to Dr. Stroud.

In practice it is found that, with the new apparatus, the various adjustments for size of type, length of line, and line interval are quite easily made by blind persons, and that the instrument, with all its delicate adjustments, can remain in use for a long time without anything getting out of order. It is therefore safe to say that the problem of opening the world's literature to the blind is now definitely solved.

The Kalahari and Ovamboland.

By PROF. E. H. L. SCHWARZ.

THE Kalahari and Ovamboland belong physiographically to one and the same province; the former is a region of red sand and the latter of white sand. The whole area, some 350,000 square miles, is blocked by an encircling ring of hard rocks, breached on the east by the Victoria Falls, on the south by the Aughrabies Falls on the Orange River, and on the west by the great cataract (300 ft. high) on the Cunene River. The consequence of this peculiarity is that the whole region is flat and the rivers have scarcely any fall, the floods seeping rather than flowing along the sandy river-beds and blocking up the channels with bars made of branches, reeds, and other rubbish, so that there has been a constant changing in the distribution of the water.

On the west there are two great depressions, the Makarikari and the greater Ngami. Livingstone obtained the impression that the two formed the bed of one enormous lake, but the map of Passarge shows the two very clearly defined. The greater Ngami is a depression elongated in a south-westerly direction, with parallel sides, and 300 miles long by 100 miles broad; part of the breadth in the northern half is occupied by sand dunes, so that the effective area is now less than that of Victoria Nyanza; but before it was tapped by the Zambezi it must have been a little larger. The Zambezi enters the depression at the Mambove Falls, follows the northern boundary, and leaves the old lake at Kasungula. It is not certain when the Zambezi first breached the wall and let out the waters of the lake; the Portuguese maps before Livingstone's time showed the river beginning not so very far above Zumbo, and we know that the Portuguese had a very good idea of the country so far back as the sixteenth century. The Falls cannot be of very great age, because the gradient below them is more than 15 ft. to the mile, and a great river like the Zambezi would have flattened out the gradient if it had been of any considerable age. The recent earthquake at New Langenburg, at the head of the Loangwa River, shows that the area is one of great seismic activity, so that the original idea of Livingstone and Murchison, that the crack was formed by

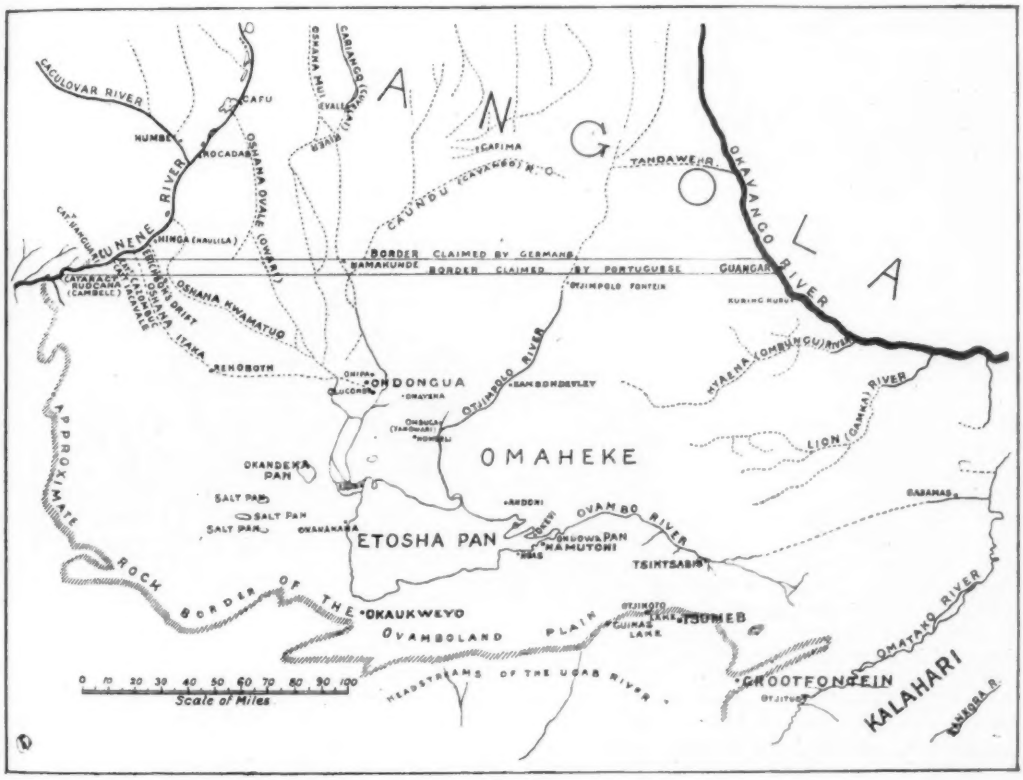

FIG. 1.

such agency, is worth reconsidering. Certainly the idea that the river has worked back along joints requires some modification, because the depth of the crack, reckoning from the top of the Falls to the bottom of the gorge, is more than 1100 ft., and joints do not penetrate so deep.

Two rivers fan out on the floor of the depression of the greater Ngami, in the same way that the Rusisi does on the plain on the north of Tanganyika, which has been exposed since the Lukuga tapped the lake and drew off the water; this last case, according to Arab accounts, has occurred within the last 500 years or less. The Ngami feeders are the Okavango and Chobe rivers. The Chobe flowed south in Chapman's time (1852), but the channel became blocked with reeds and rubbish below the Mababe swamp, and it now goes straight into the Zambezi. The Okavango until quite recently also flowed south into the Ngami of Livingstone, but a branch, the Selinda, has developed which takes the water into the Chobe and so into the Zambezi, and Ngami is now dry.

When the Chobe and Okavango rivers flowed south to Lake Ngami the water overflowed from that lake into the Botletle, which breached the eastern wall of the depression, and so made its way to the Makarikari. This depression has an area of 15,000 square miles and two "floors"; the Soa and Ntwetwe Pans form the lowest levels, while around are immense grass flats. We know fairly definitely that this dried up about 1820, thirty years before Chapman was there, and the Bushmen described to him how the whole expanse was then covered with dead hippopotamus and fish. Now the Botletle very seldom reaches the Makarikari, though the floors may fill for a few weeks from drainage from the east.

When the waters of the upper Zambezi were impounded in the Ngami depression, the water flowed south from the Makarikari into the Letwayo or Okwa, and found its way into the Molopo and so to the Orange River. According to traders who have crossed this part many times, the old channel can still be traced; certainly the lower Molopo has a bed far greater than would have been cut had it only carried the waters from the tributaries now shown to connect with it. The region between the Makarikari and the bend of the Molopo is the "Great Thirst"; the main routes through the Kalahari are now fairly safe and the Government has put down bore-holes for the accommodation of travellers, but it is still exceedingly difficult to explore away from the main tracks. The natural slope of the plain of the Kalahari is to the S.S.W., so that there was nothing to prevent the original river taking the course indicated; when the water was diverted to the Zambezi the area became a waste of sand. The French in the western Sahara have similarly shown that the ergs or sand deserts occupy the basins of former river systems.

Ovamboland is just a great level river plain, the ideal peneplain. Every part of it is covered with shallow depressions, sometimes connected, forming rivers; at others they are in parallel series of disconnected hollows, elongated in the direction of the nearest river. In between are sandy tracts covered with forest. In this there are a number of wide, open tracts, which form the main habitable areas, and each of these openings is occupied by a separate tribe of Ovambos. On the north there are the Cunene and Okavango rivers, which have built themselves above the plain, and in flood-time they overflow their banks and send the water down spillways which, in former years, filled up all the depressions and converted the country into a swamp; something like a third of the plain was then submerged. As the flood subsides, the crops, which are planted on series of little sand-hillocks, rapidly come to maturity in the damp, steaming atmosphere, the palms and morula-trees yield wine, and the lot of the Ovambo was then a pleasant one.

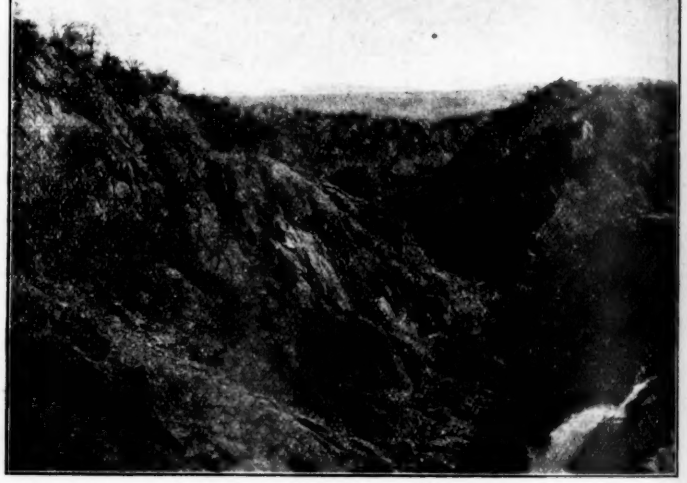

FIG. 2.—Rucana Cleft, Cunene River.

The spillways from the Okavango still carry water out from the river southwards, but not in sufficient quantity to reach any distance; and those from the Cunene are quickly diminishing. The rapid lowering of the beds of the main rivers by erosion has resulted in the desiccation of the country, and at no very distant date Ovamboland will become a land of the "Great Thirst" like the Kalahari. The conversion of an area of

70,000 square miles from the condition of a tropical swamp, similar to the Bahr-el-Ghazal, into a wilderness of dead trees and withered grass has had a very bad effect on the climate of South Africa, and the consequences are noticeable north as well as south of the Zambezi; the completion of the process is a matter of a few years only. What has happened in Ovamboland occurred in the Makarikari a hundred years ago, and in the central Kalahari not so very long before that; so, section by section, this great area has lost its water-supply, and between 300,000 and 400,000 square miles of country have become desert within comparatively recent times.

The spillways from the Cunene on one side, and those from the Okavango on the other, connect in the great depression to the south, the Etosha Pan. This is a "floor," like the Soa and Ntwetwe Pans, only here there is no trace of brak, the level pan being covered with a dark green film due to microscopic plants which turn a yellowish-green when moistened with water from a thunderstorm. Very little water finds its way into the pan down the river channels nowadays. The grass flats round the pan are some 5 ft. above the level of the floor, and are often black with zebras, wildebeests, gemsbok, koodoos, and springbok, with the attendant lions. The late Mr. J. W. F. Breijer was game ranger at the time of my visit, and it is due to his tireless efforts to suppress poaching that the game has returned to the district; to him also I owe the tracing of the Lion River, a spillway from the Okavango to the Etosha, thus completing the through connection of the Cunene and Okavango rivers.

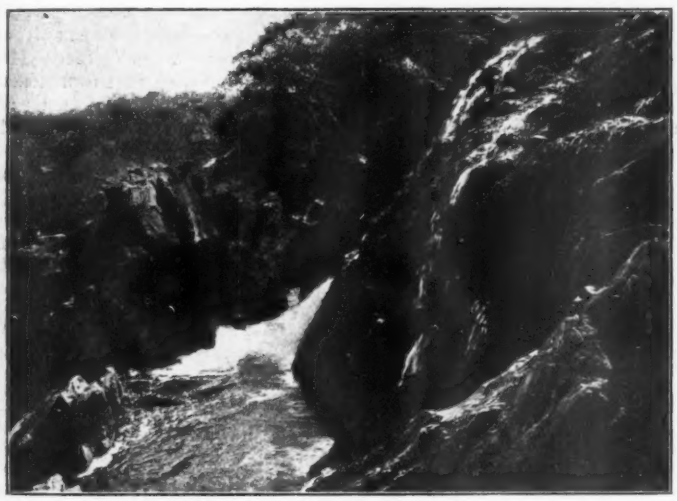

FIG. 3.—Cambele Cataract, Cunene River.

The restoration of the Kalahari and Ovamboland plains by weiring up the outlets on the north and turning the waters of the Cunene on one hand, and of the Okavango and Chobe rivers on the other, would convert these countries into habitable regions once more. Both rivers are necessary, for the one reinforces the other. Ovamboland would be converted into a swamp, a condition of affairs which the natives are accustomed to and thrive on; as it is, they are always on the verge of starvation, and in 1915–16 thousands did die of starvation, and their bones are strewn for 200 miles along the road from Ondongua to Tsumeb, the terminus of the railway, where they had expected to get food and work. Ovamboland is not suitable for white settlement, but from the evaporation from this vast swamp the rivers, like the Zambezi and Okavango, would be reinforced at their sources, and their diminishing volume converted into an increasing one. The Kalahari, on the other hand, is eminently suited for white settlement; with water anything will grow; cotton is indigenous and would form the summer crop as in Egypt; wheat grows as a winter crop, and mealies (maize) as an autumn one. Away from the actual irrigation furrows the ranching possibilities are enormous. The country is now nominally under Bechuana chiefs; but, while every consideration can be paid to their wants, a meagre population of 150,000 natives cannot indefinitely hold up a country of 300,000 square miles. White settlement could proceed without interfering in any way with the natives, as there is room enough for all.

The effect on the climate of South Africa is another matter. We know that hippopotamus swarmed all over the Karroo in not very distant times, for their bones are dug up all over it in the dry river-beds. Before the Makarikari went dry in 1820, Barrow, Lichtenstein, and Le Vaillant described finding hippopotamus in enormous quantities in typical Karroo country like Cookhouse, and the banks of the rivers were clothed with subtropical forest, in which roamed rhinoceros, elephant, eland, etc. The Karroo within the last 120 years, in the eastern portion, was a country similar in flora and fauna to British East Africa. Would the restoration of the Kalahari affect the Karroo? The lost lakes formed the end of the series of great lakes in Central Africa, and the function of these latter is to provide moisture for the inland regions. The central areas of Africa lie so high that moisture blown in from the sea is dropped on the edge by the diminution of pressure, and very little is left for the centre from these sources. With the Kalahari lakes restored and the vegetation once more established, it seems reasonable to suppose that the effect will be the same as that produced by the great northern lakes on their neighbouring regions.

The Royal Academy.

EVERY critic of the Royal Academy finds material for praise or for condemnation from whatever point of view he regards the works exhibited, and the scientific visitor is no exception to this rule. Indeed, it is impossible that among so large a number of works all should be of the same high order of merit as are the few produced by master hands. From the scientific point of view it is not difficult to divide the sheep from the goats—the true representations of Nature from the grotesquely unreal. It may be presumed that the perpetrators of the latter type of work visit the Academy and there study the pictures of their fellow-artists. If this be so, it is astonishing that they should continue from year to year to produce unreal caricatures of natural objects, when often in close contiguity to their pictures are to be seen beautiful representations of the same type of scenes, truthful to life in every particular, and gaining immeasurably thereby. The fact that both obtain admittance to Burlington House must be taken to demonstrate that both are of artistic merit, but there the similarity ends.

An example of this contrast in methods of dealing with a subject may be found in this year's exhibition by comparing "Off the Land" (38) with "Sunset at Sea" (347). Both show sea and sky scenes. The former gives a perfectly natural representation of light from the sky reflected in the sea, while in the latter an intensely red sunset sky meets at the horizon an intensely blue sea, a condition unlikely to obtain while water possesses its normal powers of reflection. The effect is so entirely unnatural that it is difficult to believe, without reference to the title, that the lower part of the picture is meant to represent water at all. In Gallery No. III., on either side of the chief centre piece, with which the scientific critic is not concerned, are two pictures of yacht racing which form an interesting contrast. When looked at from near-by the one is wholly delightful, while the other is spoilt by its crude sky. When, however, a view is taken from a considerable distance, the two pictures appear of more equal merit. The contrast between the two methods of treatment is brought out strikingly by the juxtaposition of the pictures, be it accidental or otherwise.

A feature of the present exhibition which will strike the visitor is the extraordinary sea-colouring in several of the works, though examination of the catalogue shows that for this a single artist is largely responsible. One case has already been cited. To mention one other from among several examples, it would be very surprising to meet in Nature with the contrasts in colouring depicted in "The Sunken Reef" (177). The writer has not had any opportunity of studying dazzle-painted ships in their natural surroundings, but if in the work "In the Narrow Seas" (200) Mr. Norman Wilkinson has given a correct representation of the effect produced—and there seems no reason to doubt that this is the case—it is well brought home to the landsman how baffling the effect must have been to the commanders of enemy submarines. In "The Forerunner" Leonardo da Vinci is seen showing a model of his flying machine to Ludovico Sforza, Duke of Milan, and his Court. Some of the spectators look amused, and for this the modern airman will find little difficulty in forgiving them. Several of Leader's beautiful scenes are exhibited. In studying "An Autumn Evening" (139) one wonders what object outside the picture casts a shadow over the lower part of the trees, while the upper part is illuminated with an evening glow; but there is no temptation to doubt the truthfulness of the portrayal.

J. S. D.

Obituary.

Capt. E. W. Creak, C.B., F.R.S.

CAPT. ETTRICK WILLIAM CREAK, who died in his sleep on April 3, was the son of the late Commander William Creak, of Norfolk, and a nephew of Sir H. Havelock, of Lucknow fame. He joined the Navy in the navigating branch of that Service about the year 1849, and served in various ships afloat until he was selected in 1868 to serve as an assistant in the compass department of the Admiralty. His service afloat was distinguished not only by his nautical acquirements and the remarks he sent from time to time to the Hydrographer, for which he was specially thanked in 1866, but also by his knowledge of French and music, rather rare acquirements in those days. He was able to add to our knowledge of some unsurveyed localities by his study of surveying operations, particularly by a plan of Ngaloa Bay, in the Fiji Islands, when serving in H.M.S. *Esk* about 1866. About this time Capt. Creak turned his attention to the errors of the compass on board certain ships which had traversed a great range of magnetic latitude, which inquiry was embodied in a report to the Admiralty and published by the Board of Trade. This marked him out as a suitable officer to be employed in the investigation of compass errors in H.M. ships, which were being increasingly constructed of iron and steel. For his services in the compass department and his magnetic reports he was made a fellow of the Royal Society in 1885, and he became superintendent of the Admiralty compass department in 1887.

Capt. Creak took an active part in the determination and control of the constants required for

the reduction of the magnetic observations made by the *Challenger* expedition, 1872–76, during which expedition it was discovered that the coral islands of Bermuda lay over a magnetic field in which the variation of the compass differed as much as 6°, viz. from 4° W. to nearly 10° W., the true variation of the needle being 7° W.; this was ascertained by swinging the *Challenger* on every point in deep water close to the islands, and this process was continued on board that vessel in many other parts of the world, where the true variation was affected by local attraction on shore, so that the results of the shore observations were not trustworthy; but the *Challenger* being a wooden vessel, although not entirely free from iron in her construction, better results were obtained by swinging her in deep water near the land. The results of the *Challenger* observations are published in vol. ii. of the official narration of the voyage, and in vol. ii. of the reports on the physics and chemistry of the expedition, where plans, constructed by Creak, are given of the magnetism observed at the Bermuda Islands, and also charts of the variation, inclination, horizontal force, and vertical force for the epoch 1880, constructed mainly from the *Challenger* observations, combined with all other observations available to the date of publication.

Capt. Creak pointed out in his magnetic contributions that at certain positions in the world magnetic shoals exist which affect the compasses of vessels sailing over those shoals. One such shoal near Cossack, in North Australia, was crossed by H.M. surveying vessel *Meda*, in a depth of 8 fathoms, with two shore objects transit, and the compass needle was deflected 30° for about one mile.

At Funafuti, another coral atoll in the Pacific, in lat. 8° 30′ S., long. 179° 12′ E., another magnetic field exists, where the variation changes nearly 2°, and the dip 1°, in different localities, as shown by the magnetic survey of the atoll made by Admiral Sir A. Mostyn Field in H.M.S. *Penguin* in 1896, the results being investigated by Capt. Creak, and published by the Royal Society in 1904. Capt. Creak also instructed the officers engaged in the Arctic expedition of 1875–76 under Capt. G. S. Nares, R.N., and prepared the directions and magnetic charts for the "Arctic Manual," 1875. He also prepared the magnetic instructions for the Antarctic expedition of 1901. When, owing to his having reached the age of fifty-five, he had to retire from active service afloat in 1890, and to his not having served the number of years afloat to entitle him to be retired with the rank of captain, a special Order in Council was issued giving him that rank, so that his important services in the compass department should not deprive him of the honour he would have received had he served the requisite number of years at sea.

During Capt. Creak's service in the compass department the late Lord Kelvin invented a compass superior to that then in use in H.M. ships, which was adopted by the Admiralty; but, owing to the increase in the size of the guns in H.M. ships, this compass was eventually discarded for a liquid compass brought out by Capt. Creak, which is now the standard instrument afloat, and is furnished with a special azimuth circle for use in torpedo-boats, destroyers, etc., all other compasses having failed to stand the vibration and motion and the gunfire in these vessels. He also brought out a simple form of instrument for correcting by magnets the heeling errors, and invented the Lloyd-Creak dip and intensity apparatus, originally meant for observations afloat, but which has been found very useful also on shore. This instrument was fully described in *Terrestrial Magnetism* for October, 1901.

In 1903 Capt. Creak was president of the geographical section of the British Association, and in his presidential address at Southport in that year gave an interesting account of the progress of our knowledge of magnetism both afloat and ashore up to that time, which was published in the Proceedings of the British Association, and also in the *Geographical Journal*, vol. xxii., 1903. He was made a C.B. in 1901, in which year he was retired from the compass department at the age of sixty-six. Capt. Creak also assisted the late Sir Frederick Evans and Mr. Archibald Smith in preparing and publishing the "Elementary Manual for the Deviations of the Compass in Iron Ships" in 1870, and after the death of Sir F. Evans later editions of that manual were entirely prepared and published by Capt. Creak. In the ninth edition prepared by him in 1895 the question of heeling error and its correction was specially discussed, and tables were given to assist in the correction of quadrantal deviation and the application of the Flinders bar, etc. T. H. T.

Sir Edmund Giles Loder, Bart.

The death of Sir Edmund Loder at the age of seventy removes from the ranks of English country gentlemen one of the cultivated members of that class. Possessed of ample means and abundant leisure, Sir Edmund devoted his youth and middle age to field sport and travel in many lands. In the pursuit of big game in four continents his fine marksmanship enabled him to make the very large collection of horned and other trophies now preserved at Leonardslee. He was among the last of British sportsmen to take toll of the dwindling herds of bison in North-west America, and the first European to obtain a specimen of the little desert antelope, named after him, *Gazella Loderi*, which inhabits the Sahara contentedly without access to water.

Were that all, it would scarcely serve to raise Sir Edmund Loder above the common ruck of big-game shooter and globe-trotter; but he possessed and exercised the gift of accurate observation, enabling him to acquire much sound knowledge of the habits of wild animals, and to distinguish their specific affinities. Unfortunately, he had

not the knack of recording his experience. Not only was he destitute of all turn for literature, but the mere act of putting pen to paper was intolerably irksome to him. This is the more to be regretted, because the few papers on zoology and botany which he contributed to scientific journals contained sound, and sometimes important, information.

Sir Edmund's indolence in this respect had no counterpart in his botanical work, for he took infinite personal pains in the delicate operation of hybridising rhododendrons. His crowning achievement in that line has been the magnificent cross between *R. Griffithianum* and *R. Fortunei* which appropriately bears the name *R. Loderi*, and is generally admitted to be the grandest hardy hybrid hitherto raised in that genus. The collection of conifers which he formed and grew at Leonardslee contained more species than any other in the United Kingdom.

Only a few weeks before Sir Edmund's death the present writer spent an afternoon with him in the wonderful landscape he had created at Leonardslee. The early Asiatic rhododendrons were already ablaze; there was no warning in that fair scene; but now comes Horace's dirge irresistibly to mind:—

> Linquenda tellus et domus et placens
> Uxor, neque harum quas colis arborum
> Te, præter invisas cupressus,
> Ulla brevem dominum sequetur.

HERBERT MAXWELL.

PROF. WILHELM PFEFFER, FOR.MEM.R.S.

W. PFEFFER, who died on January 31 last at Leipzig, was born in 1845 near Cassel, the son of an *Apotheker*; he studied at a number of German universities, his Ph.D. being taken at Göttingen. He was first a Privatdozent at Marburg, then assistant-professor at Bonn, and later full professor at Basel, in Switzerland. In 1878 he went to the University of Tübingen, and in 1887 to the University of Leipzig, where he remained for the rest of his life. He was elected a foreign member of the Royal Society in 1897. Pfeffer may be associated with Sachs as the founder of modern plant physiology. He and the late Prof. Strasburger, of Bonn, were for a long time the two best-known German botanists, and for many years they drew to their respective laboratories numerous foreign workers, particularly from the United States. Pfeffer was the author of many scientific papers, but he is perhaps best known for his "Pflanzenphysiologie," of which the first edition appeared in 1880, and the last part of the second edition in 1904; the second edition was translated into English. This handbook was a truly monumental work, in which a wealth of material was dealt with with great critical insight; hence it was for many years the standard and invaluable reference book on the subject. Pfeffer's work in 1877 on osmotic pressure, which laid the foundation of our more exact knowledge of that phenomenon, must also be referred to. With his death the three outstanding figures of the older German botany—Sachs, Strasburger, and Pfeffer—have all passed away. V. H. B.

IT is with much regret we learn of the death, on February 20, of MR. MAXWELL HALL, Government Meteorologist of Jamaica. Mr. Maxwell Hall was a barrister-at-law and resident magistrate for the district of Hanover. His interest in meteorology has placed the knowledge of the weather of Jamaica on a better basis than that of any other West Indian island. He succeeded in establishing a weather service in Jamaica in 1880, the objects being to encourage the recording of rainfall and to foretell the approach of hurricanes. In 1911 rainfall records were available from 194 stations, with observations at each for at least ten years. It is hoped that this fine record of work will not be interrupted by the death of its originator. For upwards of thirty years Mr. Maxwell Hall was a fellow of the Royal Meteorological Society.

THE death is announced of LORD GUTHRIE, one of the senators of the College of Justice in Scotland, at seventy-one years of age. Charles John Guthrie was admitted to the Faculty of Advocates in 1875, and, after a successful career at the Bar, was appointed a Judge in the Court of Session in 1907. Lord Guthrie was for a time president of the Royal Scottish Geographical Society and chairman of the Early Scottish Text Society. His interest in antiquities led to his election as member of the councils of the Antiquarian and Scottish History Societies. He was joint author of the memoirs of his father, the Rev. T. Guthrie, D.D., founder of the Ragged Schools and editor of the *Sunday Magazine*. In the world of literature he will be best remembered as a friend in youth of Robert Louis Stevenson, of whose nurse, "Cummy," he published an appreciation in 1914.

MEMBERS of the British Association who have attended any meeting for many years past will learn with regret of the death of MR. H. C. STEWARDSON, the chief clerk and assistant treasurer. Mr. Stewardson's record of devoted work was particularly notable. He entered the service of the association in 1873, being encouraged to do so by William Spottiswoode, president of the association in 1878, to whom he was apprenticed in the printing business. The annual reports of the association owe much to his careful reading and indexing, and he was also specially concerned with the work of the Corresponding Societies Committee, and compiled its valuable annual catalogue of communications to local scientific societies. Mr. Stewardson was a member of the Stationers' Company.

THE RIGHT HON. SIR THOMAS W. RUSSELL, Vice-President of the Department of Agriculture and Technical Instruction for Ireland from 1907 to 1918, died on May 2 in his eightieth year.

Notes.

THE first conversazione of the Royal Society this year will be held in the rooms of the society at Burlington House on Wednesday evening next, May 12.

A SUMMER meeting of the Institution of Naval Architects will be held in Liverpool on July 6–8. Meetings for the reading of papers will be held, and arrangements will be made to visit some of the principal shipbuilding and other works in Liverpool and its vicinity.

SIR HENRY A. MIERS, Vice-Chancellor of the Victoria University of Manchester, has been re-elected president of the Manchester Literary and Philosophical Society for the session 1920–21. Dr. H. F. Coward and Prof. C. A. Edwards have been elected honorary secretaries.

A PUBLIC meeting, arranged by the National Union of Scientific Workers, will be held on Tuesday next, May 11, at 8.30 p.m., at the Imperial College Union, Prince Consort Road, South Kensington, for the discussion of "The Economic Position of Scientific Workers." The chairman will be Dr. H. M. Atkinson, and the subject will be introduced by Prof. J. B. Farmer and Dr. J. W. Evans.

SIR HENRY BIRCHENOUGH has been appointed chairman of the British Dyes Corporation in succession to Lord Moulton, whose resignation is announced. Sir Henry was chairman of the Royal Commission on Paper, 1917; of the Committee on Cotton-growing in the Empire, 1917; and of the Advisory Council to the Ministry of Reconstruction, 1918.

A COMMITTEE of fellows of the Royal Society and members of the University of Cambridge has been formed for the purpose of collecting funds for a memorial to be erected in Westminster Abbey to the late Lord Rayleigh in recognition of his eminent services to science. Lord Rayleigh was both president of the Royal Society and Chancellor of the University, and an appeal has been issued by the society and the University. It is thought, however, that there may be some men of science unconnected with either of these bodies who may wish to show their appreciation of Lord Rayleigh's work. Donations may be sent to the hon. treasurers of the fund, Sir Richard Glazebrook and Sir Arthur Schuster, at 63 Grange Road, Cambridge.

THE council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1919–20:—Telford gold medals and Telford premiums to Mr. David Lyell, Mr. J. K. Robertson, and Major-Gen. Sir Gerard M. Heath; a George Stephenson gold medal and a Telford premium to Mr. Maurice F. Wilson; a Watt gold medal and a Telford premium to Mr. P. M. Crosthwaite; and Telford premiums to Major E. O. Henrici, Sir Francis J. E. Spring, Mr. F. O. Stanford, Mr. J. Mitchell, Mr. J. W. Sandeman, and Dr. A. R. Fulton.

LT.-COL. SIR LEONARD ROGERS, I.M.S., has recently returned from India on a year's leave on medical certificate, on the expiry of which he will have only a short period of Indian service remaining before being retired under the age rules. As he has completed the organisation of the Calcutta School of Tropical Medicine for opening next autumn with a full staff, he does not propose to return to India, but to devote himself to continuing his researches on the treatment of tuberculosis, which have already yielded some promising results in India, and have arisen out of his successful method of treating leprosy by injections of soluble preparations of the unsaturated fatty acids of various oils.

AT the annual general meeting of the Marine Biological Association, held in London on April 28, Sir E. Ray Lankester was re-elected president of the association, and Sir Arthur Shipley chairman of council. The Rt. Hon. Sir Arthur Griffith-Boscawen was added to the list of vice-presidents, and Messrs. T. H. Riches and Julian S. Huxley became members of council for the first time. The council reported that donations amounting to 1770*l.* had been promised towards the erection of new laboratories and the equipment of a department of general physiology. Scientific work at Plymouth during the year had been specially directed to a comparison of the condition of the trawling grounds with that which had been observed before the war, to the continued study of the distribution of post-larval and young adult stages of fishes and the food eaten by fishes when in these stages, and to observations on the invertebrate fauna, particularly on the rate of growth of various organisms.

THAT the Plumage Bill was "talked out" in the House of Commons last Friday is probably due to the fact that it did not come before the House until the day was far spent. As a private members' Bill, its chances of success, should the debate be resumed on some future Friday, are not great. The Hon. E. S. Montagu spoke briefly, and to the point, in its favour, remarking that the Government was extremely anxious to see the Bill passed into law. He did not believe, he said, that the passing of the measure would destroy any legitimate trade. Lord Aberdeen's Bill, which is on its way to the Commons, affords yet another chance, though a slender one, for necessary legislative action. It does not seem to be realised, even by zoologists, that the matter is one of real urgency, not merely for ornithologists, or for those who desire to protect birds for their own sake, but for all who are concerned with problems of economic zoology and pure science. It is therefore devoutly to be hoped that this matter will at once be taken up by men of science in all seriousness. Their considered opinion is necessary if any Bill restricting the import of plumage of wild birds is to become law before extermination has set its seal upon a number of species which are well within the "danger-zone."

THE need has long been felt for a corporate body analogous to the Institute of Chemistry which would represent the profession and strengthen the position of workers engaged in physics, and would also form a bond between the various societies interested. The

Institute of Physics has been founded for this purpose by the co-operation in the first instance of the Faraday Society, the Optical Society, and the Physical Society of London; and the first board is constituted from representatives appointed by the councils of these societies. It is hoped that in the course of time other societies will associate themselves with the institute. There will be three classes of members: Ordinary members, associates (A.Inst.P.), and fellows (F.Inst.P.). Only the two latter classes, membership of which will require full professional qualifications, will be corporate members. The institute has already received promises of support from leading physicists, and the initial expenses are covered by a guarantee fund amounting to more than 1200*l*. The first president of the institute is Sir Richard Glazebrook, Sir Robert Hadfield is treasurer, and Prof. A. W. Porter honorary secretary. The other members of the board are:—Dr. H. S. Allen, Inst.-Commander T. Y. Baker, R.N., Prof. F. J. Cheshire, Dr. R. S. Clay, Mr. W. R. Cooper, Prof. W. H. Eccles, Major E. O. Henrici, Dr. C. H. Lees, Mr. C. C. Paterson, Major C. E. S. Phillips, Dr. E. H. Rayner, Mr. T. Smith, and Mr. R. S. Whipple. Mr. F. S. Spiers has been appointed secretary to the institute, and further particulars and forms of application for membership may be obtained from him at 10 Essex Street, Strand, W.C.2.

DURING the last ten years important research work on the corrosion of metals, and particularly on condenser tubes, has been carried on by the Corrosion Research Committee, which was founded under the auspices of the Institute of Metals. Very considerable progress in the study of this difficult subject has been made by the investigators acting under the direction of the committee, and the five reports which have been issued contain most valuable information, both as to the factors which influence corrosion and as to the methods of preventing corrosion, especially in the case of marine condenser tubes. The financial support of the investigations has been provided partly by the Institute of Metals and partly by the makers of tubes and of condensers. More recently a grant has been received from the Department of Scientific and Industrial Research. The cost of the investigations is, however, considerable, and the committee now makes an appeal for further funds from the users of tubes and condensers, who are equally interested in the question with the manufacturers. The continuance of a Government grant is contingent on a sufficient sum being provided by persons interested in the research. The persons affected by the work include shipbuilders and shipowners and also the insurers of ships, and it is hoped that a sum of something like 1000*l*. per annum can be raised from this source. Particulars of the work may be obtained from the secretary of the Institute of Metals, 36 Victoria Street, Westminster, London.

AT the annual general meeting of the Institution of Civil Engineers held on Tuesday, April 27, the result of the ballot for the election of officers for the year 1920-21 was declared as follows:—*President:* Mr. J. A. Brodie. *Vice-Presidents:* Mr. W. B. Worthington, Dr. W. H. Maw, Mr. C. L. Morgan, and Mr. Basil Mott. *Other Members of Council:* Mr. E. A. S. Bell, Dr. C. C. Carpenter, Col. R. E. B. Crompton, Mr. M. Deacon, Sir Archibald Denny, Bart., Sir William H. Ellis, Mr. A. Gordon, Mr. W. W. Grierson, Sir Robert A. Hadfield, Bart., Sir Brodie H. Henderson, Mr. E. P. Hill, Mr. G. W. Humphreys, Mr. Summers Hunter, Mr. H. G. Kelley, Mr. C. R. S. Kirkpatrick, Mr. J. Marchbanks, Mr. H. H. G. Mitchell, Sir Henry J. Oram, Mr. F. Palmer, Capt. H. Riall Sankey, Sir John F. C. Snell, Mr. W. A. P. Tait, Mr. A. M. Tippett, Mr. E. F. C. Trench, Prof. W. H. Warren, and Sir Alfred F. Yarrow, Bart. This council will take office on the first Tuesday in November next.

THE annual meeting of the members of the Royal Institution was held on May 1, Sir James Crichton Browne, treasurer and vice-president, in the chair. The annual report of the Committees of Visitors for the year 1919, testifying to the continued prosperity and efficient management of the institution, was read and adopted, and the report of the Davy Faraday Research Laboratory Committee was also read. Sixty-four new members were elected during the year, and sixty-two lectures and nineteen evening discourses were delivered. The following gentlemen were unanimously elected as officers for the ensuing year:—*President:* The Duke of Northumberland. *Treasurer:* Sir James Crichton Browne. *Secretary:* Col. E. H. Hills. *Managers:* Dr. Horace T. Brown, Mr. J. H. Balfour Browne, Mr. J. Y. Buchanan, Mr. Burdett-Coutts, Sir James J. Dobbie, Dr. J. Dundas Grant, Dr. Donald W. C. Hood, the Right Hon. Earl Iveagh, Mr. H. R. Kemps, Sir Ernest Moon, the Hon. Sir Charles Parsons, Sir James Reid, Bart., Sir Ernest Rutherford, the Right Hon. C. Scott-Dickson, and Sir Henry Wood. *Visitors:* Sir Hugh Bell, Bart., Sir William H. Bennett, Mr. W. R. Bousfield, Mr. J. G. Bristow, Dr. Frank Clowes, Mr. Montague Ellis, Mr. W. E. Lawson Johnston, Mr. J. R. Leeson, Mr. T. B. Lightfoot, Mr. F. K. McClean, Mr. W. S. Norman, Mr. H. M. Ross, Mr. J. Shaw, Mr. T. H. Sowerby, and Sir Almroth Wright.

AT the anniversary dinner of the Royal Academy of Arts, held on May 1, the president, Sir Aston Webb, in proposing the toast of "Science," remarked that to science and scientific research in medicine and surgery they were indebted for the marvellous record of freedom from disease and saving of life which was one of the most wonderful and gratifying chapters in the war. To the physicist and engineer were due much of the work done in connection with aircraft, tanks, submarines, and guns, the wonderful work done in sound-ranging for submarines, the location of aircraft and guns by sound; but it was impossible to give any list of all that was done, and still less the names of the men of science who thus helped their country in its time of urgent need. The president coupled the toast with the name of Sir Joseph Thomson, who, in replying, said that the qualities of mind

that were called into play by the artist were in many respects identical with those used by the man of science. Imagination and observation were vital to scientific discovery. The artist and the man of science were concerned with the same subject—the study of Nature under various aspects. While it was vital for the progress of this country that the application of science to industry should receive every encouragement and assistance, yet they ought not to neglect those who, forsaking the trade routes of the great liners, steered their little ships to uncharted seas to bring back to us the golden fleece.

SIR JAGADIS BOSE gave a very interesting lecture at the University of London Club on Thursday evening, April 29, on his well-known experiments on movements in plants. He has applied the methods of instrumental physics to the study of tropic plant movements, and, beginning with methods which magnified the growth one hundred times, has finally, with his high magnification crescograph, reached magnifications of more than ten million. This instrument uses the principle of a fine magnetised lever affecting a magnetic needle and so demonstrating growth by the movement of an attached mirror. By this method very delicate growth responses of the plant could be shown, and its relative sensitivity under different conditions compared. One of the lecturer's most general conclusions was that indirect stimulus causes an increase of growth, while direct stimulus of a plant organ causes a decrease of growth or contraction. In this way positive, negative, and neutral responses to gravitation or light on the part of any organ were explained as the result of various combinations of response to direct and indirect stimulus. Sir Jagadis Bose's crescograph is so remarkably sensitive that doubt was recently expressed as to the reality of its indications as regards plant growth; and the suggestion was made that the effects shown by it were due to physical changes. A demonstration at University College, London, on April 23, has, however, led Lord Rayleigh and Profs. Bayliss, V. H. Blackman, A. J. Clark, W. C. Clinton, and F. G. Donnan to state, in the *Times* of May 4: "We are satisfied that the growth of plant tissues is correctly recorded by this instrument and at a magnification of from one to ten million times." Sir W. H. Bragg and Prof. F. W. Oliver, who have seen similar demonstrations elsewhere, give like testimony that the crescograph shows actual response of living plant tissues to stimulus.

FURTHER news from Capt. Roald Amundsen confirms the belief expressed in NATURE of April 22 and 29 that he had not abandoned his North Polar journey. His object in calling at Nome, Alaska, in July is evidently to secure more supplies, add to his crew, and to receive mails. A long despatch published in the *Times* of May 1 gives some details of the fortunes of the expedition and explains the change in plans. The *Maud* left her winter quarters in the Nordenskjöld archipelago west of Cape Chelyuskin as late as September 12, 1919. It was necessary to blast a channel through about one and a half miles of solid floe six to nine feet thick. Until the Taimir peninsula was cleared pack offered some obstruction, but to the eastward the sea proved to be fairly open. The lateness of the season was in Amundsen's favour in this part of his journey, and he was no doubt trusting to former accounts of open water in September. The *Maud* sailed east through Laptev Strait between the New Siberia Islands and the mainland and then turned north-east for Jeannette Island, but was stopped by tight pack in lat. 73° N. Amundsen made fast to the floes, intending to begin his drift, but on finding that the pack was nearing south he had to abandon his attempt. He decided to winter on the coast of Siberia, and after a passage rendered dangerous by ice and darkness reached Aion Island, Chaun Bay. One member of the expedition spent the winter with the Chukchee, who inhabit the interior of this part of north-eastern Siberia, in order to study their customs. Two men sent overland to the small trading village of Nizhne-Kolimsk with despatches for home turned back at Sukharnoe, a village at the mouth of the Kolima, with news that all communications with Europe were cut off. Amundsen hopes to reach Nome in July or August, and, if not too late in the season, to return north and enter the ice about Wrangel Island for his five years' drift.

WITH reference to the note in NATURE of April 15, p. 210, upon the laboratory of applied psychology connected with a well-known institute of mind-training, the director informs us that the fees charged are very considerably less than the cost of the tests performed or the scientific advice given, and that the laboratory is projecting the publication of research papers giving details of the work done, so that the world of science in general will be able to examine the methods adopted and the results obtained.

WITH the return to peace the increased cost of production has made it necessary to devise a new scheme for the publication of the "Victoria History of the Counties of England." Hitherto no order for fewer than ten volumes relating to a single county has been accepted, but it has been found by experience that there is a considerable demand for separate articles on special subjects. It has therefore been decided to issue the History, both that portion which has already been published and the remainder which is in preparation, in separate parts. Each part will include a single hundred, wapentake, or borough, and persons interested in the history, archæology, or economics of a special area will be able to procure what they require within a single cover. The new arrangements seem well adapted to popularise a work which has already taken the rank of a standard authority on the subjects with which it deals.

SIR THOMAS MUIR, the well-known mathematician, and until lately Superintendent-General of Education in Cape Colony, has recently made a splendid gift to the South African Public Library, Cape Town. It consists of about 2500 books and pamphlets, collected by the donor in the course of many years, and it includes a number of serials, sets of which are now almost un-

procurable. As might be expected, there is an unusually complete group of works on determinants and allied topics. The gift is of special interest because it is made to a *public* library. Several of our college and university libraries have been enriched by similar donations (*e.g.* there is the Graves collection at University College, London). The time has come when we may hope that the reference departments of our rate-supported town libraries will be strengthened in a similar way. Of course, mathematics is not the only subject deserving attention; natural science, history, archæology, economics, etc., all have a claim to be considered. Anyone who cares to examine the present record of public research libraries will be convinced that such gifts as that of Sir Thomas Muir are not likely to be wasted.

THE meeting of the Physical Society of London on March 26 took the form of a discussion on Einstein's theory of relativity. Prof. A. S. Eddington opened with an explanatory lecture. Prof. A. O. Rankine described experiments undertaken in collaboration with Dr. Silberstein on the influence of a gravitational field on the velocity of light polarised in a plane parallel to the field; the results of the experiment were in accord with the theory. Sir Joseph Larmor contributed a paper in the course of which he remarked that "the unresolvable essence of relativity appears to be that we cannot get on without *some foundation* to which phenomena are referred, and with respect to which they are ordered to the degree that is necessary for our reasonings." Reference was made also to the close relation between the theory and the fundamental principle of least action. That principle furnishes the most concise and elegant means of comprehending Einstein's theory. Here Helmholtz was a pioneer, not only in his grasp of physical principles, but also in his appreciation of the true nature of geometry. The searching question was asked: "How is it that astronomers since Newton's time have persisted in one special and very precise illusion about the distribution of gravitation, whereas really an unlimited choice is open?" Several speakers raised questions about the interpretation of the Michelson-Morley experiment, indicating that the explanations offered both by Lorentz and by Einstein still remain unconvincing to many physicists.

THERE are many chemists, and doubtless other scientific workers, who, busy with their everyday duties, have not been able to follow closely the progress made during the last few years in the study of atomic structure, and would welcome a connected survey of recent experiments and present views. Hence attention may be directed to an address by Prof. A. Berthoud on "The Structure of Atoms," a translation of which appears in the *Chemical News* of April 9 and 16. This gives, in simple language, a very readable account of the matter. It shows the connections which have been traced between the phenomena of radio-activity, isotopy, atomic numbers, Moseley's law, Bohr's theory, and the spectra of the elements; and it indicates to what extent the fundamental characters of atomic structure may now be regarded as known, however much of detail may still be waiting for the sagacity of the investigator to fill in.

MESSRS. ILFORD, LTD., in issuing a second edition of their well-known booklet on "Panchromatism," have taken the opportunity of revising it and making some important additions. The largest of the new sections explains the nature of three-colour photography, in which is demonstrated the fact that in three-colour half-tone prints, granting the use of satisfactory inks, the result is the same whether the dots are side by side or superposed. The variability of so-called "white light" is treated of, the table of the multiplying factors of colour-filters is greatly extended, and a considerable number of new filters are described. The most novel and interesting of these last are the "photographic-vision" filters, which have transmissions that correspond with the sensitiveness of an orthochromatic or panchromatic plate, and therefore, when looked through, give the object or landscape the appearance that it will have when photographed on the plate that it matches. The effect of any colour-filter on the photograph is seen at once by putting the filter together with the "photographic-vision" filter in front of the eye. The price of the booklet is 6*d*., or post free 9*d*.

MESSRS. A. GALLENKAMP AND CO., LTD., have forwarded us a copy of their list (No. 72) of graduated instruments for volumetric analysis. These include burettes, pipettes, graduated cylinders, and various kinds of measuring flasks for use in the chemical and physical laboratory; we do not, however, notice pyknometers in the list. The instruments are made in three qualities, depending upon the degree of accuracy required. Those intended for research and special work (Grade A) are graduated according to the regulations laid down by the International Congress of 1909. Apparatus of the next quality (Grade B) is intended for specially accurate commercial analysis; and that in Grade C is suitable for ordinary technical determinations and general school-work. It is satisfactory to know that our makers of scientific glassware are endeavouring to meet the requirements of all users, including those of research workers. Whilst writing on this subject we may note that, from a report appearing in the Journal of the Society of Glass Technologists (December, 1919), there is a movement in Germany to restrict and standardise the shapes and sizes of glass vessels such as beakers, flasks, retorts, cylinders, and crystallising dishes in order to eliminate unnecessary diversity and facilitate replacement. The proposed standard dimensions are quoted at length.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, W.C.1, have just issued a list (dated April) of new books and new editions added to their medical and scientific circulating library during January, February, and March of the present year. Being very comprehensive and carefully classified, it should be useful to all who wish to keep abreast of current scientific literature. Copies can be obtained free of charge upon application to the publishers.

Our Astronomical Column.

THE LUNAR ECLIPSE.—On the whole this eclipse was seen under favourable weather conditions, though for a time there was drifting cloud. The eclipsed portion was easily visible, being at first of a greenish tint, and later assuming the familiar coppery hue. Mr. A. Burnet had prepared a list of stars occulted during totality; they were few, and faint, and only one of these phenomena was observed at Greenwich. There will not be another total lunar eclipse visible in London with the moon at a considerable altitude until November 7, 1938, which is a much longer interval than usual.

THE NATURE OF PHOTOGRAPHIC IMAGES.—Dr. Kenneth Mees, director of the Research Institute of the Eastman Kodak Co., New York, gave an address at the meeting of the British Astronomical Association on April 28 on the nature of photographic images. Various points were raised that are of importance in the application of photography to astrophysics. Thus in the extra-focal determination of stellar magnitudes it was demonstrated that stars of different colours might have their magnitudes arranged in a different order, according to the exposures given and the developer employed.

Magnified sections of films were thrown on the screen, showing that with some developers the image of a luminous object caused an elevation of the film, but with other developers a depression. In either case the film in the neighbourhood suffers strain (sometimes to the point of cracking), so that images of faint stars near a bright one are subject to displacement. Prof. Turner noted some time ago an apparent displacement of a star near a *réseau* line which was probably due to this cause. It is possible to minimise the effect by a judicious choice of developer. The address contained many other hints of a practical nature; it will be published in the B.A.A. Journal for April. The Astronomer-Royal, proposing a vote of thanks, said that photography was the only way of obtaining information about the fainter stars in bulk. While some of the phenomena described by the lecturer were a little disquieting, the careful analysis of their origin and effects could not fail to be of great value.

THE BINARY KRUEGER 60.—This system is of particular interest as being one of our nearest neighbours, and since the *comes* has the smallest mass yet found for any star. *Astronomical Journal*, No. 767, contains researches on the parallax, proper motion, and orbit made at the Leander McCormick Observatory by S. A. Mitchell and C. P. Olivier. They find for the relative parallax $0{\cdot}266'' \pm 0{\cdot}009''$. Combining this with the determinations of Barnard, Schlesinger, and Russell, and adding $0{\cdot}005''$ as the estimated value for the comparison stars, the absolute value $0{\cdot}261'' \pm 0{\cdot}006''$ results.

Their orbit makes the period nearly fifty years, a being $2{\cdot}68''$, or 10 astronomical units. Hence the combined mass is 0·42 in terms of the sun. The ratio of masses of the two components is still uncertain; three estimates are 0·35, 0·53, and 0·83. Taking it as 0·5, the faint component is 1/7th of the sun in mass, while it is only 1/2500th of it in luminosity. Prof. Eddington considered that the minimum mass necessary for the attainment of a stellar state may not be much below 1/7th of the sun.

It is pointed out that the photographs of the close pair give as good results as visual measures, while for the distant optical component, observed for the purpose of deducing the relative masses, they are more accurate. Comparisons continued for another twenty-five years should give a satisfactory determination both of the orbit and the mass-ratio.

Leonardo da Vinci.[1]

By EDWARD MCCURDY.

AMONG the greater names in the history of Italian art some are found to be pivotal by reason of the influence of their work upon that of other artists. Giotto and Masaccio are the most conspicuous instances among the earlier masters. Giotto created the scientific basis of the naturalism of the art of the Renaissance by contrast with the decorative symbolism of the earlier art of Byzantium. Masaccio reinforced these tenets with noteworthy access of realism in the frescoes in the Church of the Carmine in Florence. The names of Antonio Pollaiuolo and Andrea Verrocchio serve to indicate how in Florentine art of the Quattrocento the study of structure gained new scientific precision from anatomical research. Piero de' Franceschi reveals a deeper knowledge of the various problems of perspective, arrangement, and light and shade in his works at Arezzo than was possessed by any of his contemporaries, but the influence which his work would naturally exert was restricted by reason of its remoteness from the greater centres of art training.

The divergent aims of this small band, who may be termed the upholders of the scientific tradition in Italian art, are realised with singular completeness in the work of Leonardo da Vinci. Born in the year 1452, the illegitimate son of a Florentine notary, descended from a long line of Florentine notaries, having shown, according to Vasari, marvellous talent as a boy in the art of design, he was placed by his father in the studio of Andrea Verrocchio, who is described by the same writer as at once goldsmith, master of perspective, sculptor, inlayer of woods, painter, and musician. It was apparently a sort of clearing-house for ideas for the art world of Florence, and there Leonardo became acquainted with Botticelli and Perugino. His apprenticeship had ceased in 1472, for in that year his name occurs in the Red Book of the Guild of Painters of Florence.

In the year 1483 Leonardo, being then in his thirty-second year, left Florence and went to Milan, where he entered the service of Ludovic Sforza. Making all possible allowance for what may have been lost, the sum total of his work in art up to this time is astonishingly small as covering the period from his apprenticeship to his thirty-second year. Already in his few pictures the detailed treatment of the herbage, the gradation of the light, the presentment of muscle and tendon, all reveal the scientific study of the laws which defined their structure. The inference is irresistible that while still at Florence he had commenced those studies of natural and applied science the rumour of which, superimposed upon the fame of his artistic work, caused his name to be endowed among his contemporaries with a half-legendary universality. Some of the forms of this nascent activity are enumerated by Vasari. I quote from the translation by Mr. Herbert Horne:—

"In architecture he made many drawings, both of plans as of other projections of buildings; and he was the first, although a mere youth, that put forward the project of reducing the River Arno to a navigable channel from Pisa to Florence. He made designs for flour-mills, fulling-mills, and machines which might be driven by the force of water. . . .

"And he was for ever making models and designs to enable men to remove mountains with facility, and to bore them in order to pass from one level to another; and by means of levers, and cranes, and screws he showed how great weights could be lifted and drawn; together with methods of emptying

[1] From a discourse delivered at the Royal Institution on Friday, March 19.

harbours and pumps for drawing up water from low places, all which his brain never ceased from inventing."

In the famous draft of a letter to Ludovic Sforza, in the Codice Atlantico, written presumably immediately on his arrival in Milan, Leonardo offers his services in the capacity of military or naval engineer, detailing the various inventions of which he possesses the secret, and offering to make trial of any, either in the ducal park or in whatsoever place might please his Excellency, in case any of the said inventions should seem to be impossible. If natural incredulity, which the writer of the letter apparently expected to meet with, by reason of the scope and variety of the inventions, which comprise pontoons, scaling-ladders, cannon or bombards, mines, covered chariots, catapults, mangonels, and smoke-powders, should dispose any to look on the list merely as a piece of rodomontade, it may be observed that the contents of Leonardo's manuscripts at Paris and Milan fully substantiate every claim contained in the letter.

The position which Leonardo desired to occupy under Ludovic Sforza was not very unlike that of military engineer and inspector of fortresses which he occupied at a later period in the service of Cæsar Borgia.

The concluding paragraphs of the letter to Ludovic Sforza refer to Leonardo's readiness to be employed in the arts of peace—in architecture as a designer of both public and private buildings, in the construction of watercourses, in painting, and in sculpture, whether of marble, bronze, or clay, and especially in the execution of the equestrian statue of Francesco Sforza, upon which he laboured intermittently for sixteen years. The extent and fervency of the researches that he considered necessary, which comprised studies of various antique equestrian statues, and numerous notes on the proportions of particular horses, as well as a treatise on the anatomy of the horse, were such that the very desire of perfection prevented the execution of the work. As Vasari says, quoting Petrarch's line: "L'opera fosse ritardata dal desio." The monk, Sabba da Castiglione, who was present when the French entered Milan in 1499, records the fact of the destruction of the clay model under the arrows of the Gascon bowmen. The statue ranked with Donatello's Gattamelata at Padua and Verrocchio's Bartolommeo Colleone at Venice as one of the three great examples of equestrian statues of the Italian Renaissance. So far as it is possible to form an opinion from the very numerous studies in the Royal Collection at Windsor, it would seem to have been in advance of both the others in freedom and vigour of movement. The sequence of studies shows a change of purpose from the attitude of the horse galloping to that of it walking. Leonardo says in a note in one of his manuscripts, "The trot is almost the nature of the free horse."

Few paintings are now in existence the execution of which can be connected with Leonardo's first period of residence in Milan. The most important of these is the haunting ruin of the Last Supper. The paucity of the list, even allowing for the inevitable mischances of time, confirms the testimony of Sabba da Castiglione, who says that, besides the Last Supper, few other works in painting by Leonardo were to be seen at Milan in the middle of the sixteenth century, "because when he ought to have attended to painting, in which without doubt he would have proved a new Apelles, he gave himself entirely to geometry, architecture, and anatomy."

The external history of his life is sharply divided by circumstances into three periods. First the early years at Florence. Then his life at Milan under Ludovic Sforza. The third period was that of the Odyssey of wanderings commenced on his leaving Milan with Fra Luca Paciolo two months after the flight of Ludovic Sforza, and extended for the remaining twenty years of his life.

At Venice, as Leonardo's manuscripts show, he studied the tides of the Adriatic, and apparently prepared a scheme for flooding part of the Veneto in order to stem the Turkish invasion, and also an apparatus by which it would be possible to approach the Turkish galleys under water. A note in the Codice Atlantico tells of his hurried departure from Florence to travel in the Romagna as architect and military engineer in the service of Cæsar Borgia. His manuscripts refer to works planned at Urbino, Cesena, and Porto Cesenatico. But the office ended with the rebellion of the Duchy, and in March, 1503, Leonardo was once more back in Florence. There he was employed to divert the channel of the Arno, in connection with the war with Pisa. He painted at this time the portrait of Madonna Lisa del Giocondo, the world-famous Mona Lisa, and also the cartoon for the Battle of Anghiari. His work on this composition was interrupted by an invitation to Milan, and this led to his entering the service of the French. Louis XII. refers to him in a letter to the Signoria as "our painter and engineer in ordinary." He consulted him as to the conduit in the garden of the Château of Blois, and employed him on hydraulic work in Lombardy. It was probably in May, 1509, when Louis XII. made a triumphal entry into Milan after the victory of Agnadello, that Leonardo constructed as part of the pageant an automatic lion which walked a few paces and then, opening its breast, revealed it full of lilies. There was much study of anatomy with Marc Antonio della Torre at this period, and his intercourse with French artists is shown by a note to inquire from Jean de Paris the method of painting in tempera, but he did not engage in any great artistic work.

In the year 1512 the French lost Milan, and after the re-entry of the Sforzas, in the person of the young Maximilian, there is no record of Leonardo's further employment. On September 24 in the following year he set out from Milan to Rome with his assistants, and was there lodged in the Belvedere of the Vatican. According to Vasari, the Pope gave him a commission, and then was indignant because he began by experimenting with the varnish. The practice of painting, however, had no more than a secondary interest for him. His manuscripts reveal him as engaged in studies in optics, acoustics, and geometry, studying geology in the Campagna, improving the method of coining at the Mint at Rome, busy with engineering work at Cività Vecchia, and in studying anatomy at the hospital, for which last-named pursuit he was denounced to the Pope by one of his apprentices. He seems to have gone with the Papal army to Bologna, where in December, 1515, the Concordat was held between the Pope and Francis I., and a month later he accompanied the king on his return to France with the office of "his painter and engineer," being given as a residence the Château of Cloux, near Amboise, where he died on May 2, 1519.

A record of a visit paid to him at Cloux by the Cardinal of Aragon on October 10, 1517, makes special mention of the anatomical drawings, and the diarist states that Leonardo told the visitors that in preparation for these he had dissected more than thirty bodies. They saw also his treatise on the nature of water, and others on various machines, there being, as it appeared, "an endless number of volumes, all in the vulgar tongue, which if they be published will be profitable and very delectable."

The activities of Leonardo's mind fall naturally into

such as found expression, either mainly or in part, in constructive work and those revealed only in his writings. The first category comprises painting, sculpture, architecture, and engineering. In painting it is enough to instance the fresco of the Last Supper and the portrait of Mona Lisa, each of its type unique among all works of the Renaissance, and beyond all power to appraise in its union of technical mastery and the inevitability of supreme art. In sculpture the Sforza statue, the master-work of his Milanese years, lives only in the drawings which furnish some faint index of its power. In architecture there is no outstanding memorial.

Sir Theodore Cook, in his elaborate study of spiral forms entitled "The Curves of Life," has collected a remarkable array of evidence in favour of attributing to Leonardo the design for the open spiral staircase in the Château of Blois. The documentary evidence is missing, but the date of construction is known to have been between the years 1516 and 1519, and Leonardo was then living a few miles distant in the manor-house of Cloux, near Amboise. A spiral staircase occurs in one of Leonardo's drawings for a fortified tower, and he made many studies of spiral formations occurring in Nature, in shells, in smoke, and in the eddies of water. The staircase at Blois is apparently modelled on *Voluta vespertilio*, a shell common on the coast of northern Italy. The theory has obvious attractions. It supplies an example of a work in architecture emanating from the brain of Leonardo, and this a work of supreme distinction.

Records of his activity as an engineer are concerned with schemes of canalisation in Florence, in connection with the diversion of the Arno from Pisa as a war measure; and in Friuli, in similar circumstances, he devised movable sluices in order to prevent the advance of the Turks across the Isonzo. He made canals in Lombardy for purposes of irrigation, and also aqueducts to improve the water-supply of Milan; and the canal of Romorantin, for which he made plans when in France, was intended to connect the waters of the Loire and the Saône.

The potential list of Leonardo's activities in the construction of instruments of warfare figures in the letter to Ludovic Sforza. He says there: "I can make armoured wagons safe and immune from attack which will open up a passage through the enemy with their artillery, and, however great the multitude of the enemy may be, they will be able to break through. And behind them the infantry will be able to follow quite unhurt and without hindrance."

This armoured wagon is seen ready for action in a drawing in the British Museum. It is moved on wheels, and a sketch of the lower half shows the internal machinery, but it is not possible to discern the nature of the motive power. The use of the armoured wagon in order to open up a passage through the enemy, as described above, is identical with that of the tank in the late war. The manuscripts reveal a strangely prophetic insight in regard to two other developments of recent warfare, namely, poison gas and submarining.

Leonardo contemplated the use of poisonous gas or powders in naval warfare for the purpose of suffocating the enemy, and told how to make a simple preventive mask. He also contemplated the contingency—as happened on occasions in Flanders—of an adverse wind causing the poison to recoil upon the users. The passage, which occurs in MS. B of the Paris manuscripts, is entitled "How to throw poison in the form of powder upon ships."

"By means of catapults," he says, "a mixture of powdered quicklime, arsenic, and verdigris may be thrown upon the ships of the enemy, and all who inhale the powder will die.

"But take care that the wind is favourable, lest it blow the powder back upon you, and be sure you have a fine piece of damp cloth to cover the nose and mouth in order that the powder may not enter."

In the Leicester manuscript (folio 22*b*) he foretells the horrors of submarine warfare, and refuses to impart any information as to the machine which he has constructed lest it should serve to bring them about:

"How by means of a certain machine many people may stay some time under water. How and why I do not describe my method of remaining under water, or how long I can remain without eating; and I do not publish or divulge this because of the evil nature of men who would use them as means of destruction at the bottom of the sea by smashing the ships in the keel and sinking them together with the men in them. But I will impart others which are not dangerous, because the mouth of the tube by which you breathe appears above the water supported on leather bottles or corks."

In connection with this passage reference may be made to one in MS. B of the Paris manuscripts entitled "A Way of Escaping in a Tempest or Shipwreck at Sea," in which Leonardo tells how to construct a coat of leather of double thickness which will be capable of being inflated when necessary, and thus of serving as a life-saving jacket in case of emergency.

Senatore Luca Beltrami associates the former of these passages with the Turkish war. Leonardo, as a reference to his manuscript shows, had been employed in the construction of a movable dam which should enable the line of the Isonzo to be flooded in the defence of the Veneto against the Turkish invasion. The reference is to the construction of submarine boats in order to sink the Turkish galleys in the Gulf of Venice "by smashing the ships in the keel and sinking them together with the men in them." Leonardo considers this to be justifiable, because it is an act of defence "for the safety of our Italian lands" ("delli nostre parti italiche"); but he will not give any details of the construction of his submarine craft in which it would be possible to remain under water for four hours, because he is fearful of the evil use to which it might be put in future times.

(To be continued.)

Public Support of Scientific Research.

ON Wednesday, April 28, a public meeting was held at Birkbeck College to hear an address from Prof. F. Soddy on "The Public Support of Scientific Research." Mr. H. G. Wells, who took the chair, claimed that everything in which the world of to-day differed from that of years ago was due to science and the scientific worker. Prof. Soddy expressed his regret that the greater encouragement of scientific research during the war had not resulted in any appreciable improvement in the position of pure science, which was the tree of which applied—industrial and trade—science were the fruits. He deprecated the exploitation of science by financiers and commercial men and its employment to increase the indebtedness to them of those who had done the creative work of the world. The scheme framed by the Government to foster scientific research endeavoured to place the man of science who was to do the work under the same type of men—often the same men—as had thwarted progress in the past. The change from gross inefficiency in the medical

services in the Boer War to singular efficiency in the late war was due to change in the status of the Army medical officers and to their liberation from the misdirection of unqualified superiors. This was possible only because of the great strength of the professional union of medical men. A similar strong professional union comprising every qualified man of science was necessary before science ceased to be misdirected and used to the hurt rather than to the good of the community.

Not a single chemist was included in the directorate of the national scheme for the manufacture of British dyes when it was announced, although the taxpayer contributed 2,000,000*l.*, a portion of which was to be expended in research. The cause of the success of the German industry was that it was under scientific direction from end to end. Prof. Soddy complained that the benefaction of Mr. Carnegie to foster scientific study and research at the Scottish universities had been diverted to the general maintenance of the universities. At one time none of the trustees were men of science, and the secretary was now the administrative chairman of the Government Department of Scientific and Industrial Research. That Department allocated a million to industrial research associations in the form of a capital grant, over which Parliament was powerless, whereas researches in the fields of pure science, from which directly flowed all the useful applications, were put on the yearly Parliamentary Estimates. The research associations were becoming water-tight concerns to eliminate competitors, and the interests neither of the public nor of the scientific worker were protected. Representatives both of trained scientific workers and of organised labour should be included in the councils and executive committees of the research associations. At the same time, Prof. Soddy urged that representatives of democratically constituted associations of scientific workers should be placed on the Council of the Department, of which it should be the governing body. He declared his belief that co-operation would replace competition; but this co-operation depended upon a dominance of individuals of intellect and knowledge—not over men, but over Nature; for the struggle of man against Nature was, in the first instance, a duel fought by lonely men in the furthest outposts of knowledge, finding a path where all before had turned back beaten and befogged.

In the discussion which followed Sir William Bragg urged that as science slowly established its position and men of science reached a condition of greater equity, responsibility came with it, and they must work and learn to handle greater and greater things, so that they might take their part in everything that was done in the State. He expressed his appreciation of the assistance he had received from the Department of Scientific and Industrial Research.

American Agricultural Research.

RECENT numbers of the *Journal of Agricultural Research* (vol. xviii., Nos. 7 and 8) contain several articles dealing with plant physiology and with insect pests. Plants grown in water-culture are not able to withstand such high concentrations of nutrient salts without showing toxic effects as are plants grown in sand or soil. In the latter case the presence of solid particles, which cause a considerable amount of absorption, has much to do with this reduction of toxicity, but J. A. Le Clerc and J. F. Breazeale have shown that the effect is also partly due to certain soluble substances which are sometimes present in very small quantities. Traces of calcium oxide and calcium sulphate do much to overcome the toxicity of sodium chloride and sodium sulphate, but the various other salts tested had no ameliorating action. The lime, however, does not seem to prevent the entrance of the sodium chloride or sulphate into the plant-cells, and therefore its antagonistic action would appear to be due to some undetermined cause rather than to its effect upon the permeability of the cells.

The question of the physiological balance of the salts necessary for plant nutrition is many-sided, and J. W. Shive approaches it from the point of view of the relation of the moisture in solid substrata to the physiological salt-balance and to the relative plant-producing value of various salt proportions. Under his experimental conditions the physiological value of salt solutions was not affected by the degree of moisture present, and that which was best with the lowest moisture-content was also the best with the medium and the highest degrees of moisture. Nevertheless, an optimum moisture-content is necessary to produce maximum growth, and the actual plant-producing value of any fertiliser treatment is largely determined by the moisture conditions of the substratum.

It is customary to subject cereal seeds to treatment by hot water or various chemicals in order to control plant diseases when their presence on the seed is known or suspected. Such treatments are not effective in every case, as measures that are sufficiently drastic to cut out the disease often result in destroying the viability of the seed. D. Atanasoff and A. G. Johnson find that these difficulties may be largely overcome by the use of dry heat for disinfection, as such cereals as barley, wheat, rye, and oats are able to withstand protracted exposures to dry heat at comparatively high temperatures, especially if the seed is of good quality and well dried. The method has proved successful in the elimination of seed infection from bacterial blight of barley (*Bacterium translucens*) and bacterial blight of oats (*Pseudonomas avenae*), and a number of seed-borne fungus diseases, such as wheat-scab, spot-blotch of barley, stripe disease, and smut, are either practically eliminated or much reduced. The dry heat treatment seems to offer possibilities which should be followed up.

Natural enemies must be regarded as a great asset in the control of insect pests, but the value of fungal parasites in this respect is often overlooked. A. T. Speare describes experiments on *Sorosporella uvella*, an entomogenous fungus which attacks Noctuid larvæ, and is recorded for the first time in America. The practical interest of the investigation lies in the fact that quite a number of Noctuid larvæ, including such pests as cutworms, have proved to be susceptible to the disease, and other Lepidopterous larvæ can also be infected by special methods. The disease caused by the organism is readily transmitted to healthy insects, and in laboratory experiments a mortality of from 60 to 90 per cent. may be obtained. Control by means of parasitism has proved of great value in reducing the Mediterranean fruit-fly in Hawaii. Four larval parasites of this pest have been introduced and established since 1913, and their value as destroyers increased until in 1918 they caused the destruction of considerably more than half of all the fruit-flies developing in fruits about Honolulu (H. F. Willard).

The ravages of the broad-bean weevil (*Bruchus rufimanus*, Boh) in California have led to the abandonment of a considerable acreage, especially since weevil-infested beans have been classed as adulterated food. R. E. Campbell (Bull. 807, Professional Paper, U.S.A. Dept. Agric.) gives an account of the distribution and life-history of the pest and discusses various measures of control. The only practicable means is to plant seed which contains no live weevils,

as the application of poisons or deterrents in the field is useless. Dry heat is unsatisfactory, as temperatures that destroy the weevils kill the seeds also; sulphur is unsuccessful, but fumigation of well-matured and dry seeds with carbon bisulphide gives good results. Damp seeds should not be treated. Contrary to expectation, it was found that fumigating while the insects were in the larval stage was less effective than if done in the adult stage, as the gas cannot penetrate into the interior of the bean to the partly grown larvæ as easily as it can reach the full-grown larvæ, pupæ, or adults directly under the seed-coat. W. E. B.

Canadian Water-Power Development.

AN interesting article in the *Engineer* of April 9 by Mr. Leo. G. Dennis, Hydro-electric Engineer of the Canadian Commission of Conservation, reviews the situation in regard to Canadian water-power development. From it we have gathered the following particulars indicating the remarkable growth since the commencement of the century.

In 1900 less than 200,000 h.p. was utilised, as compared with 2,383,240 h.p. now available, according to the most recent returns, subdivided as follows:—

Province.	Horse-power.
Ontario	1,000,000
Quebec	900,000
British Columbia	310,000
Manitoba	78,600
Alberta	32,500
Nova Scotia	30,000
New Brunswick	17,000
Yukon	13,400
Prince Edward Island ...	1,700
Saskatchewan	40

Of the total electric central station installation of 2,107,743 h.p., no less than 1,806,618 h.p., or more than 85 per cent., is in hydro-electric stations, and these are remarkable for their large size. Forty per cent. is in plants of 100,000 h.p. and more, and another 42 per cent. in plants between 10,000 and 100,000 h.p. Particularly worthy of note are two large hydro-electric systems in Eastern Canada. The Niagara system is supplied mainly from plant of 211,300 h.p., and transmits to some 150 municipal distribution centres. The Shawinigan system is fed from plants with a total capacity of 270,000 h.p., and, directly or indirectly, supplies some 85 distributing systems.

Water-power is an important factor in many Canadian industries, but in none so essentially as in the case of pulp and paper manufacture. Of a total of 525,000 h.p. installed for this purpose, at least 475,000 h.p. is derived from hydraulic sources. From an economic point of view it is probable that if water-power had not been available, pulp in many cases could not be manufactured at all.

Canada's potential water-power resources are placed by recent estimates at 18,832,000 h.p., subdivided provincially as follows:

Province.	Horse-power.
Quebec	6,000,000
Ontario	5,800,000
British Columbia	3,000,000
Manitoba	2,797,000
Alberta	462,000
New Brunswick	300,000
Saskatchewan	220,000
Nova Scotia	100,000
Yukon	100,000
North-West Territories ...	50,000
Prince Edward Island ...	3,000

In Ontario, the Niagara and St. Lawrence powers are the outstanding features, although the figures in regard to the former have been at times exaggerated. Bearing in mind that it is an international source, the theoretical total available for Canada is about 2,300,000 h.p. But only about one-third of that quantity is at present available for exploitation. The large power plants installed below the Falls have not so far utilised the descent in the river below the cataract, but this mistake is not being repeated by the Chippawa-Queenston project, which will add 200,000 h.p. to the total installation. It will embrace the maximum possible head of 316 ft. The St. Lawrence powers are also partly international, and are estimated as follows:

Province or State.	Available low-water horse-power.
Ontario	387,500
New York	387,500
Quebec	1,375,000
	2,150,000

Besides its share of the St. Lawrence and Ottawa River powers, Quebec has other important possibilities, notably on the St. Maurice River and in the Sagaway basin. The present capacity of plants at Shawinigan and Grand'mère in the Upper St. Maurice is 330,000 h.p., and there is expectation of this figure being doubled at no distant date.

The Solar Eclipse of May, 1919.

PROF. L. A. BAUER contributes an article on this eclipse to a recent issue of *Science*. He notes the new interest which eclipses have recently acquired, first from their effect on terrestrial magnetism, and secondly from the gravitational deflection of light. The Carnegie Institution of Washington sent two parties to stations inside the zone of totality; Prof. Bauer himself occupied Cape Palmas, Liberia, while Messrs. Wise and Thomson went to Sobral, Brazil. There were three other stations outside the zone, and most of the magnetic observatories co-operated in a scheme of observations. The detailed results are not yet available.

Cape Palmas has a bad weather record, but this was of little importance for the magnetic work. The sun was very high, and the duration of totality, 6m. 33s., was probably the longest that a scientific party has ever enjoyed. As it turned out, the sky was clear, and small-scale photographs of the corona were secured. These were, however, subsidiary to the main work, of which Prof. Bauer says: "There were clear indications of a magnetic effect. . . . As the station was nearly on the magnetic equator, the effect was specially noticeable . . . upon the magnetic dip." He notes that the darkness was not nearly so great as at the much shorter eclipse of 1918, perhaps owing to the greater brightness of the corona. The fall of temperature was nearly 3° F., the minimum being some twenty-four minutes after totality; the maximum of humidity synchronised with this minimum. Shadow bands were not seen here, but they were observed at Sobral by Mr. Thomson.

Dr. Abbot and Mr. Moore observed the eclipse from La Paz, Bolivia, where the sun's altitude was only 5°, but their altitude of 14,000 ft. compensated for this. "Taking into account the great length and beauty of the coronal streamers, the splendid crimson prominence . . . the snow-covered mountains as a background, it seemed to the observers the grandest eclipse that they had seen." Besides photographing the corona, their special work was the measurement

of sky and solar radiation at different stages of the eclipse. Curves of these are given, which indicate that the sky radiation varies proportionally to the amount of sunlight.

Prof. Bauer then discusses the British expeditions and the observed deflection of light. As these have already been dealt with in NATURE (November 13, 1919, and elsewhere), it will suffice to mention one point. After noting that the Sobral results indicated larger deflection than those deduced from Einstein's law, and that the excess was greater in R.A. than in declination, Prof. Bauer made the suggestion that the excess might arise from the passage of the light through a rare outer atmosphere of the sun, which, like the corona, might be more extended in the equatorial regions. The residuals are too small to lay very much stress on this, unless future eclipses should indicate the same effect.

The Manufacture of Synthetic Ammonia and Production of Nitrates.

THE Ministry of Munitions announces that Lord Inverforth has arranged for the sale of H.M. Nitrate Factory at Billingham-on-Tees to Messrs. Brunner, Mond, and Co., Ltd. The purchasers will form a company to take over the factory, and will be responsible for all outstanding liabilities of the Ministry in connection with the project. This factory, the erection of which was commenced early in 1918 by the Department of Explosives Supply, was designed for the manufacture of synthetic ammonia and for the production of 60,000 to 70,000 tons of ammonium nitrate annually.

Soon after the appointment of the Nitrogen Products Committee, the monumental report of which was published in January last, the Government decided to install one or other of the processes for the fixation of nitrogen. The Committee, after thorough investigation of the problem, recommended the cyanamide process as the one best suited for this purpose in the circumstances, since the working details were well understood. This advice was at first adopted, and a contract was on the point of being negotiated, but, for reasons which are not stated, the recommendation was not acted upon.

During 1916 the Nitrogen Products Committee had established a laboratory in premises placed at its disposal in the new Ramsay building of University College, London, and the Committee's research staff, under the direction of Dr. J. A. Harker, was engaged in an experimental investigation of a number of problems relating to nitrogen fixation. Although it was not anticipated that there would be any shortage of supplies of ammonia, yet it was deemed desirable, in view of the special suitability of the synthetic ammonia process for the needs of this country, that an experimental study of it should be made forthwith, so that the required information should be available if necessary.

After a year's experimental work, the progress made was considered so encouraging that the Committee decided to establish a moderate-sized technical trial unit, and funds for the purpose were allocated by the Treasury. It was hoped, by means of this plant, that a study of the chemical engineering problems could follow upon that already made of the pure chemistry of the reactions involved, but the Committee did not suggest the establishment of the process as a war measure upon an industrial scale. In 1917, however, the Explosives Supply Department considered that the position reached in the experiments justified it in recommending the erection of a large works, in substitution for the Committee's cyanamide project, and a site at Billingham, some 260 acres in extent, was ultimately chosen for this purpose. But a number of difficulties supervened, and construction was slow, and at the time of the Armistice only a few permanent buildings and a number of temporary structures had been erected, though a large amount of plant had been ordered.

The purchasers of the factory now undertake to complete the scheme by providing the additional buildings and plant required for the synthesis of ammonia and its oxidation to nitric acid and nitrates suitable for the manufacture of explosives and fertilisers.

It is understood that the company has acquired a large amount of additional land and that it intends to develop the project on a very large scale. The factory has been re-designed on a peace as distinct from its former war basis, and in many particulars the new plant will represent a substantial advance, both in the ammonia and nitric acid sections, on anything previously used in Germany.

New Ordnance Survey Maps.

THE new edition of the one-inch and quarter-inch Ordnance Survey maps is described, with specimen sheets, by Lt.-Col. W. J. Johnston in the *Geographical Journal* for March (vol. lv., No. 3). Three types of one-inch map are to be published: the popular, the district tourist, and the outline. The popular edition has contours in orange at 50-ft. vertical interval in place of the 100-ft. and 250-ft. interval on the former one-inch maps. A new classification of roads, which divides them into ten categories, makes the main roads, coloured red, stand out prominently. Rivers and streams are shown in solid blue. Parish boundaries, which caused much confusion with footpaths, are omitted, but county boundaries are retained. Woods are coloured green. The outline edition is the present one-inch map, which in future will be printed from stone on stout paper. The tourist edition entails a combination of sheets to cover conveniently in one map certain areas frequented by holiday-makers. It is hoped to have at least eight of the tourist sheets ready before the summer. The contours are at 100-ft. and 250-ft. intervals, and the representation of relief is made more striking by the use of hachures and transparent colour layers; rivers are in solid blue and woods in green. The black printing will be the same as in the popular edition. The quarter-inch map is being issued with contours and layer colours in place of hill shading, red colour for main roads only, solid blue for streams, and no green wood symbol. The sample sections of the popular one-inch and the quarter-inch maps accompanying Col. Johnston's paper are beautiful specimens of cartography, and a great improvement on the old editions, good as they were. The tourist one-inch will be useful mainly by reason of the combination of sheets which it offers. We understand that arrangements have been made to popularise these maps by having them on sale at all booksellers' and bookstalls.

University and Educational Intelligence.

CAMBRIDGE.—Gifts totalling 1500*l.* are announced towards the partially endowed Hopkinson professorship in thermodynamics.

The Linacre lecture will be delivered to-day, May 6, by Dr. Henry Head on "Aphasia and Kindred Disorders of the Speech."

In connection with the installation of the Chancellor, it is proposed to present honorary degrees to the Prime Minister, Mr. Bonar Law, and several other prominent politicians. The following are amongst those selected for honorary degrees on the same occasion: Sir Joseph

Thomson, Sir Joseph Larmor, Sir J. G. Frazer, Prof. James Ward, Mr. C. M. Doughty, and Prof. Bergson.

The Sheepshanks exhibition in astronomy has been awarded to E. S. Pearson, scholar of Trinity College.

The first examination for the diploma in medical radiology and electrology will be held on July 27 next.

Mr. H. Hamshaw Thomas has been re-appointed curator of the Botanical Museum.

LONDON.—A course of eight lectures on "Nutrition," by Prof. E. Mellanby, at King's College for Women, Campden Hill Road, Kensington, W.8, was begun on Monday, May 3, and will be continued at 5 p.m. on Mondays and Tuesdays, May 10, 11, 17, 18, and 31 and June 1. Another course of eight lectures on "The Biochemistry of Sterols" will be given by Mr. J. A. Gardner in the Physiological Laboratory of the University, South Kensington, S.W.7, at 5 p.m., on Tuesdays, May 18 and 25, June 1, 8, 15, 22, and 29, and July 6. The lectures are addressed to advanced students of the University and to others interested in the subject. Admission is free, without ticket.

At University College, on Wednesday next, May 12, at 5.30, Dr. Charles Singer will deliver a public inaugural lecture, as lecturer in the history of medicine, on "Greek Science and Modern Science: A Comparison and a Contrast." The chair will be taken by Sir Robert Hadfield, Bart.

OXFORD.—On May 4 Convocation passed a decree gratefully accepting the offer of Mr. Edward Whitley, of Trinity College, of a sum of 10,000*l.* towards the endowment of a professorship of biochemistry, and providing that the first appointment of a professor shall be made by Mr. Whitley, subject to the approval of the Vice-Chancellor and the professors of medicine, physiology, chemistry, and pharmacology.

By another decree Convocation expressed its thanks to the British Dyestuffs Corporation for its munificent donation of 5000*l.* towards the cost of extending the organic chemical laboratory.

These gifts to the University are most timely and welcome. The opportunity thus afforded for the study of the important subject of biochemistry in the University is likely to have far-reaching results; while increased accommodation for the department of organic chemistry has for some time past been urgently needed.

THE chairman and directors of the Cunard Steamship Company have decided to contribute 10,000*l.* to the appeal fund of the University of Liverpool.

THE HON. SIR CHARLES A. SMITH, for many years Controller and Auditor-General of Cape Colony, who died a year ago, bequeathed 15,000*l.* to the Master and fellows of St. Peter's (Peterhouse) College, Cambridge, "for the advancement of education and learning, the fund to be associated with his name."

WE are glad to learn that the appeal of the College of Technology, Manchester, for 150,000*l.* for the extension of its buildings is meeting with a satisfactory response. The total amount subscribed for the extension of university education in Manchester includes the subscriptions to this fund as well as the 175,000*l.* or thereabouts subscribed in response to the appeal for 500,000*l.* for faculties other than technology.

NOTICE is given by the University of Bristol of the impending award of the Vincent Stuckey Lean scholarship in botany. The scholarship, value 36*l.* and tenable for one year, is open to graduates of any university on the understanding that the successful candidate undertakes research work in botany in the University. Applications must be made on or before May 22 to the registrar of the University of Bristol.

WHEN the University of Bristol was established in 1909 the city possessed one of the best-equipped engineering faculties in the United Kingdom; but since then great improvements have taken place in many other universities, and the time has come when, in order to hold its own, the Bristol engineering faculty needs further equipment. The Merchant Venturers, in whose college the faculty is provided and maintained, have decided, therefore, to undertake considerable extensions. The total cost of the alterations and additions will amount to about 11,000*l.*, and it is hoped that a considerable part of the extensions will be available for use during next session, when the number of advanced students in the faculty will be very greatly increased. Last term there were 1340 students in the faculty of engineering—271 in the day-time and 1069 in the evening.

THE scientific and efficient use of steel and other metals, both in mechanical and structural engineering, depends on the collaboration of the metallurgist and the engineer. The examination of metals under a microscope is, perhaps, a matter for the metallurgist rather than the engineer, but this branch of testing of materials has now become of such importance that it is essential that the engineer should be able to follow the methods employed and to judge something of the properties of a material from photomicrographs. Most engineers have some detailed knowledge of the mechanical tests which should be carried out before a particular material is used in construction, but there are large numbers who are not in touch with modern work on metallography. We have pleasure, therefore, in directing attention to six lectures on "Metallography for Engineers," by Dr. W. Rosenhain, which have been arranged to be given at King's College, Strand, W.C.2, on Thursdays at 6 o'clock, commencing on Thursday, May 13. The lectures form part of the post-graduate work of the engineering department of the college. They are, however, open to all students and engineers. The post-graduate courses for engineers at King's College deserve to be widely known. During this session the lectures have included courses on "Metrology and Engineering Standardisation," by Mr. J. E. Sears; "Central Station Practice," by Mr. C. H. Wordingham; and "Irrigation," by Mr. N. F. Mackenzie. Arrangements have already been made for similar courses next session, and full particulars of these can be obtained from the secretary of the college.

Societies and Academies.

LONDON.

Royal Society, April 22.—Sir J. J. Thomson, president, in the chair.—H. W. **Hilliar**: Experiments on the pressure-wave thrown out by submarine explosions. A method is described for determining the time-pressure curve at a given point in water in the neighbourhood of an exploded charge. The method depends, in principle, on measuring the growing velocity of a short steel piston exposed at one end to pressure in water. This method was applied in a comprehensive deep-water investigation of pressure-waves springing from a great variety of charges. Comparisons were made between various kinds of explosive, including gunpowder, which gives results remarkably different from those yielded by high-explosives. The general behaviour of the pressure-wave was found to approximate closely to that of a sound-wave. Its velocity was measured directly and found not to differ sensibly from that of sound in sea-water (4900 ft. sec.). The pressure falls off in

approximately simple proportion to distance from the charge. The influence which the water surface exercises on pressure at a given point can be accounted for by supposing that the pressure-wave is reflected from the surface as a tension-wave. The first part of the pressure-wave arrives at the point in question entirely unaffected by proximity of surface; but after a certain interval, determined by the difference in length of direct and reflected paths, the remaining pressure is obliterated by the arrival of the tension-wave.—E. F. **Armstrong** and T. P. **Hilditch**: A study of the catalytic action at solid surfaces (iii.). The hydrogenation of acetaldehyde and the dehydrogenation of ethyl alcohol in the presence of finely divided metals. *Hydrogenation of Aldehyde*.—Aldehyde may be converted into alcohol by passing the vapour together with hydrogen over either copper or nickel (Sabatier); but in presence of the latter metal, probably owing to the special affinity of nickel for the carbonyl group, the aldehyde is prone to undergo decomposition into carbon monoxide and methane. Copper at 200–220° effects reduction of aldehyde to alcohol smoothly, but at 300° about 50 per cent. of the aldehyde disappears and but little reduction is effected, the recovered aldehyde and alcohol being in about equal amounts. *Dehydrogenation of Alcohol*.—The yield of aldehyde obtained from alcohol as dehydrogenated in the presence of nickel is only 35 per cent., whereas, in the case of copper, not only is the ratio of aldehyde to hydrogen close to that calculated, but the unchanged alcohol may also be recovered almost quantitatively, the yield of aldehyde being about 90–95 per cent. of that to be expected from the amount of alcohol used. There is a striking absence of the secondary products observed when aldehyde together with an excess of hydrogen is passed over the metal at the same temperature.—E. F. **Armstrong** and T. P. **Hilditch**: A study of the catalytic action at solid surfaces (iv.). The interaction of carbon monoxide and steam as conditioned by iron oxide and by copper. It is shown that, like certain forms of iron oxide, prepared copper is able to effect considerable transformation of carbon monoxide and steam into carbon dioxide and hydrogen. Whereas, however, iron oxide at a suitable temperature causes the action to proceed almost as far as the equilibrium constant permits, copper does not at its *optimum* temperature effect more than 50–70 per cent. of the possible amount of chemical change; the exact proportion is to some extent a function of the composition of the original gas employed. The action of copper commences at a little more than 200° C., and up to 300° is greater than that of an iron oxide catalyst, the latter being without appreciable effect below 250° C. The difference in behaviour is explained by the hypothesis that copper effects a decomposition of formic acid (momentarily produced from carbon monoxide and steam) into carbon dioxide and hydrogen from 190° C. upwards, whereas the iron oxide alternately oxidises carbon monoxide, and is in turn in its reduced form reoxidised by the action of steam. These results are of interest, from the point of view of the general theory of catalysis which the authors have lately put forward, as illustrating the specific action of two different types of catalyst, which produce ultimately the same change ($CO+H_2O=CO_2+H_2$), but by an entirely different mechanism, involving production of intermediate systems of quite distinct kinds.—T. R. **Merton**: The structure of the Balmer series of hydrogen lines. In a previous investigation with Prof. J. W. Nicholson it was found that the separation of the components of the lines $H\alpha$ and $H\beta$ suggested that the series should be regarded as a principal series. It is now found that the structure of these lines is not invariable, but is altered by the presence of impurities, notably helium, in vacuum tubes containing hydrogen. The optimum conditions of sharpness were found in hydrogen mixed with an excess of helium and cooled to the temperature of liquid air, and under these conditions the separations of the components approximate to those appropriate to a diffuse or sharp series. The appearance of the lines in the purest obtainable hydrogen is entirely different. Measurements have been made of the separations of the components under the optimum conditions of resolution with the aid of an échelon diffraction grating, and the physical widths of the lines and the relative intensities of the components have been deduced from the measurements. It is suggested that the structure of the lines is complex, the relative intensities of the components being variable under different conditions; the structure suggested would appear to be consistent with Sommerfeld's theoretical investigations and with the results of experiment.—H. A. **Wilson**: Diamagnetism due to free electrons.

Zoological Society, April 13.—Dr. A. Smith Woodward, vice-president, in the chair.—Prof. A. **Willey**: An apodous *Amia calva*.—H. A. **Baylis** and Lt.-Col. Clayton **Lane**: A revision of the Nematode family Gnathostomidæ.—A. M. **Altson**: The life-history and habits of two parasites of blowflies.

Geological Society, April 21.—Mr. R. D. Oldham, president, in the chair.—J. W. D. **Robinson**: The Devonian of Ferques (Lower Boulonnais). In the Lower Boulonnais, between Calais and Boulogne, lies a small tract of Devonian rocks. They form a link between the Devonian beds in Belgium, France, and Germany, and those of England geographically, and also geologically, since they appear to have been formed in a narrow strait which joined the open seas extending towards the Atlantic and over Germany and Russia.—E. S. **Cobbold**: The Cambrian Horizons of Comley (Shropshire), and their Brachiopoda, Pteropoda, Gasteropoda, etc. As the study of the Comley Cambrian fossils proceeded, it became apparent that the several faunas, sketched out in 1911 on the evidence of the trilobites (Q.J.G.S., vol. lxvii., pp. 282 *et seqq.*), and their order of appearance may prove to be of more than local interest. The author consequently proposes names for the horizons, based on their fossil contents, to replace those used in his previous publications, which were often clumsy and only of local origin, though necessary until the fossils were better known.

PARIS.

Academy of Sciences, April 12.—M. Henri Deslandres in the chair.—A. **Lacroix**: The eruption of Katla (Iceland) in 1918. This volcano, quiescent since 1860, entered in violent eruption in October, 1918. The eruption was explosive, and there was no lava flow.—G. **Bigourdan**: The instruments and observations of Bailly at the Louvre. The Observatory of the Abbey of Sainte-Geneviève, at Paris.—E. **Ariès**: The equation of state of ether. The formulæ deduced from the equation of state given in earlier communications require modification for ether. The results of the modified formula are compared with Young's experimental figures.—G. **Julia**: Families of functions of several variables.—L. **Bianchi**: Pairs of surfaces with lines of associated curvature.—C. **Camichel**: The permanent *régime* in water-chambers. An account of an experimental study of the water velocities by a photographic method.—C. **Zenghelis**: The action of finely divided gases.—A. **Gascard**: The melissic alcohol of Brodie. Myricic

alcohol discovered by Brodie in beeswax, and named by him melissic alcohol. By analysis of the alcohol it is not possible to distinguish between $C_{30}H_{62}O$ (Brodie) and $C_{31}H_{64}O$, but analysis of the iodide shows that the true composition is the latter. This has been confirmed by the preparation of the hydrocarbon $C_{31}H_{64}$, and by other reactions.—Ph. **Glangeaud**: The geyser of Martres d'Artières (Puy-de-Dome). In Iceland the motive power of the geysers is steam; that of the Martres geyser is shown to be carbon dioxide.—L. **Gentil**: The mode of formation of terraces in chalk districts. A discussion of the views of Poulett Scrope. While these are in part in accord with the views of the author, it is maintained that these terraces can be formed by purely natural agencies, and are not in all cases due to ploughing, as supposed by Poulett Scrope.—H. **Vallois** and A. **Peyron**: The first stages in the development of the coccygian glomerule in man.—A. **Krempf**: Extension of the notion of oro-aboral metamerism to the internal organisation of the larva of the hexacorals (*Pocillopora cespitosa* and *Seriotopora subulata*).—MM. **Diénert** and **Girault**: The action of activated sludge on the ammonia of sewage and of ordinary water.—R. **Legroux** and J. **Mesnard**: Vitamines for the culture of bacteria. The current view that the growth of bacteria in a culture medium stops owing to the inhibiting action of deleterious substances is held by the author to be incorrect. Most media derived from animal or plant tissues contain more or less substances (hormones) favouring bacterial growth.—A. **Paillot**: The polymorphism of bacteria.—S. **Giaya**: Zinc in the human organism. The normal presence of zinc in the body is proved, the proportion increasing with the age of the subject.

Books Received.

Invertebrate Palæontology. By H. L. Hawkins. Pp. xix+226+xvi plates. (London: Methuen and Co., Ltd.) 6*s*. 6*d*. net.

Chemical Fertilizers and Parasiticides. By S. H. Collins. Pp. xii+273. (London: Baillière, Tindall, and Cox.) 10*s*. 6*d*. net.

The Coolidge Tube: Its Scientific Applications, Medical and Industrial. By H. Pilon. Translated. Pp. v+95. (London: Baillière, Tindall, and Cox.) 7*s*. 6*d*. net.

Lad: A Dog. By A. P. Terhune. Pp. 309. (London: J. M. Dent and Sons, Ltd.) 6*s*. net.

Industrial Administration. By A. E. Berriman and others. Pp. vii+203. (Manchester: At the University Press; London: Longmans and Co.) 7*s*. 6*d*. net.

Scientific Management in the Home: Household Engineering. By Mrs. C. Frederick. Pp. 527. (London: G. Routledge and Sons, Ltd.) 12*s*. 6*d*. net.

Bibliography of Industrial Efficiency and Factory Management. By H. G. T. Cannons. Pp. viii+167. (London: G. Routledge and Sons, Ltd.) 10*s*. 6*d*. net.

The House-fly: Its Life-History and Practical Measures for its Suppression. By Major E. E. Austen. Pp. 52. (London: British Museum (Natural History).) 1*s*. 6*d*. net.

A National System of Education. Pp. 78. (Manchester: At the University Press; London: Longmans and Co.) 1*s*. net.

Physiography. By Prof. R. D. Salisbury. Third edition. Pp. xv+676+26 plates. (New York: Henry Holt and Co.)

Early English Magic and Medicine. By Dr. C. Singer. Pp. 34. (London: Oxford University Press.) 4*s*. net.

Committee of the Institution of Civil Engineers appointed to Investigate the Deterioration of Structures of Timber, Metal, and Concrete exposed to the Action of Sea-water. First Report of the Committee. Edited by P. M. Crosthwaite and G. R. Redgrave. Pp. 301+33 plates. (London: Institution of Civil Engineers). 30*s*. net.

The Columbian Tradition on the Discovery of America and of the Part Played Therein by the Astronomer Toscanelli. By H. Vignaud. Pp. 62. (Oxford: At the Clarendon Press.) 3*s*. 6*d*. net.

Silver: Its Intimate Association with the Daily Life of Man. By B. White. Pp. xi+144. (London: Sir Isaac Pitman and Sons, Ltd.) 2*s*. 6*d*. net.

Spanish Prose and Poetry: Old and New, with Translated Specimens. By I. Farnell. Pp. 185. (Oxford: At the Clarendon Press.) 10*s*. 6*d*. net.

Hydrographical Surveying. By the late Rear-Admiral Sir W. J. L. Wharton. Fourth edition, revised and enlarged, by Admiral Sir Mostyn Field. Pp. xii+570. (London: John Murray.) 30*s*. net.

Psychology and Folk-lore. By Dr. R. R. Marett. Pp. ix+275. (London: Methuen and Co., Ltd.) 7*s*. 6*d*. net.

The Atlas Geographies. Part iii. Senior Geography. No. 2: Europe. Pp. iv+148. (Edinburgh: W. and A. K. Johnston, Ltd.; London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

A Handbook of British Mosquitoes. By Dr. W. D. Lang. Pp. vii+125+5 plates. (London: British Museum (Natural History).) 20*s*.

Flora of Jamaica. Vol. iv. By W. Fawcett and Dr. A. B. Rendle. Pp. xv+369. (London: British Museum (Natural History).) 25*s*.

Catalogue of the Lepidoptera Phalænæ in the British Museum. Supplement. Vol. ii. By Sir G. F. Hampson. Pp. xxiii+619. (London: British Museum (Natural History).) 30*s*.

Arithmetic. Part 2. By F. W. Dobbs and H. K. Marsden. Pp. xii+163+xi. (Answers.) (London: George Bell and Sons, Ltd.) 3*s*. 6*d*.

Elementary Algebra. Part 1. By C. V. Durell and G. W. Palmer. Pp. viii+256+viii. (Answers.) (London: George Bell and Sons, Ltd.) 3*s*. 6*d*.

Le Parc National Suisse. By S. Brunies. Traduit par S. Aubert. Pp. 274. (Bâle: B. Schwabe et Cie.) 12 francs.

Die Gliederung der Australischen Sprachen. By P. W. Schmidt. Pp. xvi+209. (St. Gabriel-Mödling, bei Wien: "Anthropos.")

An Introduction to Sociology. By Prof. J. J. Findlay. Pp. xi+304. (Manchester: At the University Press; London: Longmans and Co.) 6*s*. net.

Diary of Societies.

THURSDAY, MAY 6.

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers) (General Meeting), at 10 a.m.—Dr. J. E. Stead: Inaugural Address.—E. H. Lewis: Iron Portland Cement.—At 2 30.—F. Clements: British Blast-Furnace Practice.—H. E. Wright: Chemical and Thermal Conditions in Blast-Furnace Practice.—C. H. Ridsdale: The Valuation of Ores and Iron-making Material.—J. A. Heskett: The Utilisation of Titaniferous Iron Ore in New Zealand.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section, conjointly with the North of England and Midland Obstetrical and Gynæcological Societies), at 10.30 a.m.—Dr. H. Tweedy and Others: Discussion on The Treatment of Antepartum Hæmorrhage.—At 2.—Dr. E. Holland and Others: Discussion on Rupture of Cæsarean Section Scar in Subsequent Pregnancy or Labour.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—R. Campbell Thompson: The Legends of the Babylonians.

ROYAL SOCIETY, at 4.30.—R. H. Fowler, E. C. Gallop, C. N. H. Lock, and H. W. Richmond: The Aerodynamics of a Spinning Shell.—Prof. W. E. Dalby: Researches on the Elastic Properties and the Plastic Extension of Metals.—C. T. R. Wilson: Investigations on Lightning Discharges and on the Electric Field of Thunderstorms.—L. F. Richardson: The Supply of Energy to Atmospheric Eddies.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. G. P. Bidder: Notes on the Physiology of Sponges. *Pandorina spongiarum*, a New Species of Alga found in a Sponge.—E. J. Bedford: The British Marsh Orchids and their Varieties, Illustrated by Coloured Drawings and Lantern Slides.

CHEMICAL SOCIETY, at 8.—G. M. Bennett: The Mustard Gas Problem.—C. K. Ingold: A New Method of Preparing Muconic Acid.—J. W. Cook and O. L. Brady: The Dinitration of *m*-Acetotoluidide.—Y. Venkataramayya and M. V. Narasimhaswamy: A New Ozoniser.—G. T. Morgan and H. D. K. Drew: Orthochlorodinitrotoluenes. Part I.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, MAY 7.

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers) (General Meeting), at 10 a.m.—C. A. Ablett: Direct Current compared with Three-Phase Current for Driving Steel Works Plant.—J. F. Wilson: Notes on Slag Conditions in Open-hearth Basic Steelmaking Practice.—B. Yaneske and G. A. Wood: The Reduction of Silicon from the Slag in the Acid Open-hearth Process.—At 2.30.—W. E. Hughes: Some Defects in Electro-deposited Iron.—T. Baker and T. R. Russell: Note on the Ball Test.—J. H. Whiteley: The Distribution of Phosphorus in Steel between Points Ac1 and Ac3.—G. F. Preston: Practical Notes on the Design and Treatment of Steel Castings.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.45.—Annual General Meeting.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Prof. R. A. Sampson and Others: The Use of Wireless Telegraphy in the Determination of Longitude.

CHINA SOCIETY (at School of Oriental Studies), at 5.30.—G. S. Boulger: The History of Silk.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. G. McBryde: Pulverised Fuel.

PHILOLOGICAL SOCIETY (at University College), at 8.—Anniversary.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Lord Rayleigh: The Blue Sky and the Optical Properties of Air.

SATURDAY, MAY 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. F. Chamberlin: The Private Character of Queen Elizabeth.

BRITISH PSYCHOLOGICAL SOCIETY (at Bedford College), at 3.30.—Dr. E. W. Scripture: Speech Inscriptions in Normal and Abnormal Conditions.—A. Klein: Camouflage in Land Warfare.

MONDAY, MAY 10.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge, Kensington Gore), at 5.—G. Dobson: Instruments for the Navigation of Aircraft.

BIOCHEMICAL SOCIETY (at Chemical Department, St. Bartholomew's Hospital), at 5.30.—T. S. Hele: The Synthesis of Mercapturic Acids in the Dog.—R. L. Mackenzie Wallis and H. E. Archer: Improved Methods of Analysis of the Gastric Juice.—G. Graham: The Source of the Uric Acid Excreted in the Urine after Atophan.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.30.—Annual General Meeting.—Surg.-Capt. Bassett-Smith: Scurvy, with Special Reference to Prophylaxis in the Royal Navy.

ARISTOTELIAN SOCIETY (at 74 Grosvenor Street), at 8.—Prof. H. Wildon Carr and Others: Discussion on Bergson's "Mind-Energy."

ROYAL SOCIETY OF ARTS, at 8.—A. T. Bolton: The Decoration and Architecture of Robert Adam and Sir John Soane, 1758-1837 (Cantor Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Association), at 8.—E. B. W. Maitland: Chemistry as applied to Boilers.

MEDICAL SOCIETY OF LONDON (General Meeting), at 8.—At 9.—Sir D'Arcy Power: Rev. John Ward and Medicine (Annual Oration).

SURVEYORS' INSTITUTION, at 8.—S. A. Smith: Rent Problems.

TUESDAY, MAY 11.

ROYAL HORTICULTURAL SOCIETY, at 3.—Sir Daniel Morris: The Use and Relative Value of Trees in Great Britain.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Keith: British Ethnology: The Invaders of England.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. W. J. Dakin: Fauna of Western Australia. III. Further Contributions to the Study of the Onychophora.—C. Forster-Cooper: Chalicotheroidea from Baluchistan.—Dr. W. T. Calman: Notes on Marine Wood-boring Animals. I. The Shipworms (Teredinidæ).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Prof. A. Findlay: Some Properties of Colloidal Matter and their Applications in Photography (Second Biennial Hurter and Driffield Memorial Lecture).

QUEKETT MICROSCOPICAL CLUB (at 20 Hanover Square), at 7.30.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8.15.—Annual Meeting.—Capt. J. W. Barber: Recent Developments in Portable Types of Cinema Outfits.

WEDNESDAY, MAY 12.

ROYAL SOCIETY OF ARTS, at 4.30.—G. Hewitt: Rolls of Honour.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 8.—Major L. Hope: Some Notes on Flying-boats.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 8.—H. Gordon: Left-handedness and Mental Deficiency.

THURSDAY, MAY 13.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. P. Graves: Welsh and Irish Folk Song.

ROYAL SOCIETY, at 4.—Election of Fellows.—*Probable Papers.*—Dr. A. D. Waller: Demonstration of the Apparent "Growth" of Plants (and of Inanimate Materials) and of their Apparent "Contractility."—W. N. F. Woodland: The "Renal Portal" System (Renal Venous Meshwork) and Kidney Excretion in Vertebrata.

LONDON MATHEMATICAL SOCIETY, at 5.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—S. Evershed: Permanent Magnets in Theory and Practice.

OPTICAL SOCIETY, at 7.30.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Section) (at 28 Victoria Street), at 8.—W. E. Benbow: The Chemical and Physical Properties of Iron and Steel.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Annual General Meeting.—Dr. S. A. K. Wilson: Decerebrate Rigidity in Man, and the Occurrence of Tonic Fits.

FRIDAY, MAY 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.—Annual General Meeting.

PHYSICAL SOCIETY OF LONDON, at 5.—Dr. F. Lloyd Hopwood: Demonstration of Experiments on the Thermionic Properties of Hot Filaments.—G. D. West: A Modified Theory of the Crookes Radiometer.—A. Campbell: The Magnetic Properties of Silicon-Iron (Stalloy) in Alternating Fields of Low Value.—T. Smith: Tracing Rays through an Optical System.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at King's College), at 7.—E. G. Humfress: Electrical Motor Control Devices.—The Meeting will be preceded by the Annual General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. Karl Pearson: Sidelights on the Evolution of Man.

SATURDAY, MAY 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Frederic Harrison: A Philosophical Synthesis as proposed by Auguste Comte.

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